EXHIBIT

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COMPARISON OF TRAFFIC CONTROL FOR MOTORCYCLE RALLIES IN MYRTLE BEACH, SC

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Overview

This report provides an assessment of traffic flow and the traffic control plans put in place during busy summer weekends in the Myrtle Beach, SC area.

Two large motorcycle rallies historically take place in the City of Myrtle Beach during the month of May. The Myrtle Beach Bike Week and Spring Rally, termed herein as "Harley Week," spans 10-days in mid-May and caters largely to owners of Harley-Davidson type motorcycles. It takes place annually south of the Myrtle Beach area and, in peak years, reportedly attracts several hundred thousand attendees.

In 1980, the town of Atlantic Beach, located just north of Myrtle Beach, organized the Atlantic Beach Bikefest, renamed in 2017 to Black Pearl Cultural Heritage and Bike Festival. This event, also called "Black Bike Week" or "Bikefest," occurs over Memorial Day Weekend and primarily attracts African-American motorcycle enthusiasts. Bikefest directly follows Harley Week, and has also had peak attendance rates of several hundred thousand. Since Atlantic Beach is very small and has limited facilities, most Bikefest attendees shop, eat, and take lodging in surrounding communities, including Myrtle Beach.

Although Harley Week attendance has gone down in recent years, it still draws a significant number of people to the Myrtle Beach area. There are also other summer weekends which bring large crowds of tourists to town similar to those in town for Memorial Day. However, the City of Myrtle Beach treats Memorial Day weekend very differently with regard to law enforcement and traffic control. Only during this weekend does the City reduce 4.4 miles of Ocean Boulevard between 29th Avenue North and 29th Avenue South to a single lane allowing only southbound traffic. Almost all of the numerous intersections accessing the boulevard are closed to exiting or entering traffic. In addition, between 10:00pm and 2:00am on Memorial Day weekend, vehicles are prevented from exiting Ocean Boulevard at any cross intersection or from entering except at 29th Avenue North. A driver exiting a location on Ocean Boulevard, such as a hotel or restaurant, and wishing to reach a location farther north along the Boulevard must follow a 23-mile one-way loop around the Myrtle Beach area back to 29th Avenue North. The loop also imposes limitations on road access in other portions of the greater Myrtle Beach area. This plan has been implemented since 2015 for Bikefest, but nothing similar is done during Harley Week or any other peak traffic period. This report evaluates whether the differences in event traffic control for Bikefest are warranted.

The motorcycle rallies, in common with other annual events, affect traffic in and around Myrtle Beach. Although Harley Week has activities at numerous venues in the area, and Atlantic Beach hosts Bikefest, attendees at both events (and tourists throughout the summer) are attracted to downtown Myrtle Beach. Those arriving from points north or south may travel Kings Highway or Ocean Boulevard, both of which run north-south through the city.

My analysis demonstrates that the traffic plan implemented for Bikefest was not justified by greater levels of traffic or attendance than other peak weekends. Although it appears that there are other weekends that have greater visitation and/or traffic, only Bikefest has a special traffic plan addressing Ocean Boulevard and featuring the loop. My analysis also shows that the special traffic plan provides no demonstrable benefits in handling traffic, and actually degrades levels of service on associated streets. For example, during the 10:00pm-2:00am period, the average loop trip took about 67 minutes during all non-Bikefest weekends. During Bikefest, the average trip time (2017 and 2018) is 256 minutes, a 282% increase. Since demand cannot be shown to be significantly higher during Bikefest, the traffic plan is the most likely cause of this significant increase in travel time.

Background and Qualifications

I am presently Executive Director of the University of Tennessee, Knoxville Center for Transportation Research, where my responsibilities include research administration, teaching, and sponsored research. I am a Research Associate Professor in the University of Tennessee, Knoxville Department of Civil and Environmental Engineering and an adjunct faculty member in the Department of Civil Engineering and Environmental Engineering at the University of South Carolina.

My 36 years in the transportation field include: management or participation in numerous research projects; teaching undergraduate and graduate level courses in roadway design, traffic engineering, transportation planning, and engineering systems; and experience in engineering design, construction, and project management. During my academic career, I have taught transportation engineering, planning, and operations courses at the undergraduate and graduate levels. I have also taught continuing education classes for working professionals through Clemson University, the University of Tennessee, and the National Highway Institute.

From 2004 until 2016, I directed the Tennessee Transportation Assistance Program, jointly funded by the Federal Highway Administration and the Tennessee Department of Transportation to provide technology transfer, continuing education, and technical assistance to county and local transportation agencies throughout Tennessee. In this role, I oversaw and participated in numerous consultations related to road and street operations, maintenance, and safety.

I have managed nearly $25 million in sponsored research. Much of my highway related work focuses on various aspects of safety.

I am active in professional associations, including the Transportation Research Board, the American Society of Civil Engineers, and the American Public Works Association. I hold a Ph.D. in Civil Engineering (Transportation), an M.S. in Civil Engineering (Transportation), and a Bachelor of Science in Civil Engineering. I am a registered engineer in Tennessee and South Carolina.

In addition to the qualifications mentioned above, I have attached as Exhibit A my *curriculum vitae*, which includes all my relevant experience as well as a list of publications I have contributed to and/or authored within the last ten years. Attached as Exhibit B is all of the cases I have testified in at trial and/or deposition within the past five years. Additionally, the opinions stated herein are based upon my knowledge, training, and experience, and they have been rendered within a reasonable degree of professional certainty.

Assignment and Compensation

I was asked to assess the traffic, traffic flow, and traffic plans put in place in the Myrtle Beach area during Memorial Day Weekend and other busy summer weekends. As part of my assessment, I reviewed the law enforcement plans in place, maps of the area, publicly-available traffic data, and traffic reports. I also supervised and coordinated a traffic study conducted during a number of weekends, which included traffic counts, moving vehicle studies, speed measurements, photographs and videos, and other observations.

For work in the field my fee is $100 per hour plus reimbursable expenses. For all other work, including preparing this report, research, and testimony, my fee is $195 per hour plus reimbursable expenses. No portion of these fees was or is dependent on the nature of my findings or on the outcome of the case.

FACTUAL BACKGROUND

Corridor Description

Kings Highway, a major arterial road in Myrtle Beach, is the local name for US Highway 17-Business. Ocean Boulevard (SC-73) departs from Kings Highway south of downtown Myrtle Beach, parallels several blocks to the east for approximately 10 miles, and then rejoins Kings Highway north of the downtown. Figure 1 shows the corridor in downtown Myrtle Beach containing the two parallel routes, along with a portion of the surrounding road network.

Through north-south motorists typically circumvent downtown Myrtle Beach using US-17 Bypass. Despite serving adjacent new developments and having a number of intersections, the bypass still provides a faster route than the older roads.

Ocean Boulevard

The portion of Ocean Boulevard this report addresses extends from 29th Avenue North south to the intersection with Kings Highway, a distance of about 5.15 miles. The road is classified as an urban minor arterial. However, while the function of an arterial road is generally mobility, Ocean Boulevard provides access to adjoining properties and numerous local streets.

Given traffic levels and a low speed limit, drivers using Ocean Boulevard face longer travel times than those on alternative routes. Nevertheless, the road is a popular venue for sightseers because it parallels the beach and passes many landmark attractions. In a 2017 Charleston Post and Courier article, Myrtle Beach Councilman Randal Wallace stated, "I always jokingly say that cruising is the 'holy grail' of Ocean Boulevard."

Ocean Boulevard has a cross-section nominally wide enough for four traffic lanes, and formerly had two northbound and two southbound through lanes. However, a "road diet" reduced the boulevard to two through lanes between 29th Avenue North and 29th Avenue South. The remainder of the traveled way was allocated to a center two-way left turn lane (TWLTL) and bicycle lanes. Raised

Figure 1. Ocean Boulevard Corridor

medians near intersections prevent use of the TWLTL for continuous travel along the boulevard.

Speed limits on Ocean Boulevard are 25 mph through the downtown, increasing to 35 mph from just below 29th avenue South to the intersection with Kings Highway. These limits are compatible with the traffic entering and leaving the road from the driveways and side streets.

Side streets intersect at frequent intervals (approx. 0.10 mile) along Ocean Boulevard between 29th Avenue North and 29th Avenue South. Altogether, there are 49 intersections along this length, 39 permitting travel between Ocean Boulevard and Kings Highway. Many cross streets have a short block east of the boulevard to access beachfront developments. The boulevard also has many driveway accesses to serve adjacent properties along both sides. On-street parking is not provided through much of the corridor, though there are some parallel parking spaces south of Williams St.

In the corridor study area, Ocean Boulevard has signalized intersections at (north to south):

- 21st Avenue North;
- Mr. Joe White Avenue;
- 9th Avenue North;
- 8th Avenue North;
- 7th Avenue North;
- 3rd Avenue South; and
- Kings Highway.

The remaining intersections are STOP controlled on the side streets.

According to SCDOT, average annual daily traffic (AADT) along Ocean Boulevard in 2017 ranged between 5,100 and 11,600, with the higher number reflecting the commercial area near 1st Avenue South. This is the total for both directions of travel. Daily traffic can be higher, but the count data provides no ready basis for determining the maximum daily traffic load. Given that the area economy is heavily focused on tourism, the peak traffic days likely fall on summer season weekends.

In the downtown area, summertime pedestrian traffic along the road can be heavy. Sidewalks are present on both sides between 29th Avenue North and 29th Avenue South. A barrier curb and gutter on each side separate the sidewalk from the travelled way.

Kings Highway

Kings Highway is an urban major arterial paralleling Ocean Boulevard. For the purposes of this study, the section of interest extends from the intersection with Ocean Boulevard north to 29th Avenue North. Through downtown Myrtle Beach, King's Highway is 0.1 to 0.3 miles west of Ocean Boulevard. Numerous side streets connect the two roads.

Kings Highway is a divided four-lane urban street south of the intersection with U.S. Highway 501, and a six lane urban street north of there. On-street parking is generally not provided.

Commercial development fronts the road along much of its length through the downtown, and the road has frequent driveway cuts that serve adjacent properties. In addition, side streets intersect at frequent intervals (approx. 0.10 mile).

Speed limits range from 45 mph on the north and south portions of the study section to 25 mph through downtown.

Within the study area. Kings Highway has traffic signals at (north to south):

- 29th Avenue North;
- 21st Avenue North;

- 16th Avenue North;
- Mr. Joe White Avenue;
- 9th Avenue North;
- Main Street (US-501);
- 8th Avenue North;
- 3rd Avenue South;
- 6th Avenue South;
- 9th Avenue South;
- 13th Avenue South;
- 17th Avenue South;
- 21st Avenue South;
- Harrelson Boulevard; and
- Ocean Boulevard.

According to SCDOT, AADT volumes along Kings Highway in the study area for 2017 ranged from 29,100 at the junction with US-501 to 25,100 near the intersection with Ocean Boulevard. The higher volumes indicate that motorists favor Kings Highway over Ocean Boulevard for north-south trips through downtown Myrtle Beach.

Summary of Event Traffic Plans

The City of Myrtle Beach uses distinctly different traffic control plans for Bikefest versus other busy summer weekends including Harley Week. This section presents the relevant differences between these approaches.

Bikefest

Since 2015, Myrtle Beach has implemented a unique traffic treatment for Bikefest. The logistics of this are remarkable given that the city has a permanent population of only 30,000 persons.

Alteration to Ocean Boulevard

Prior to Bikefest, Myrtle Beach personnel distribute thousands of pedestrian and vehicle barriers, portable signs, drums, cones, and other traffic control devices along Ocean Boulevard and to points around the city. The city assembles a Bikefest law enforcement team of around 500 law enforcement and support personnel. The officer contingent alone is twice the size of the standing Myrtle Beach police force, requiring personnel to be brought in from other law enforcement agencies throughout South Carolina. The city arranges for these officers to be fed, housed, and paid for their time.

Beginning at 6:00am on the Friday of Bikefest until the following Monday, city personnel line both sides of Ocean Boulevard with barricades to restrict pedestrian movement onto the roadway. Openings remain at parking lot entrances, beach access points, driveways, and selected intersections.

Ocean Boulevard is converted to one-way southbound movement with a single traffic lane between 29th Avenue North and 29th Avenue South. The northbound lane between these locations is reserved for emergency vehicles and law enforcement. The city maintains that this is essential to ensure that responders have ready access along the boulevard during Bikefest.

A short section of the boulevard between 29th Avenue South and Kings Highway remains two-way to allow access to Springmaid Boulevard. Barricades and police prevent northbound traffic from traveling beyond Springmaid Boulevard.

Barricades at intersections prevent right turns off of Ocean Boulevard except at 21st Avenue North, Mr. Joe White Avenue, 9th Avenue North, 3rd Avenue South, 9th Avenue South, and 13th Avenue South. Each street also has a signalized intersection with Kings Highway. The intersections at 16th Street North, 8th Street

North, 6th Street South, and 17th Street South are signalized at Kings Highway, but remain closed and reserved for emergency access. The intersection at 21st Avenue South was, for unspecified reasons, closed during Bikefest 2018. Some cross streets (e.g., 6th Avenue South) are also blocked at Kings Highway.

Signals along Ocean Boulevard remain in normal mode, despite the lack of entering vehicles at intersections and the lack of northbound traffic requiring left turn protection. This is true even at 8th Avenue North and 7th Avenue North, which are closed to traffic.

Officers are assigned to various points along Ocean Boulevard. Others patrol on bicycles and on foot. The overall police presence is very noticeable, and officers appear quick to address traffic infractions and enforce the traffic plan.

During Bikefest weekend, this operating pattern remains in effect until 10:00pm each day. Operating patterns along Kings Highway and other major area roadways remain unaltered. However, barricades placed at various points on parallel streets between Ocean Boulevard and Kings Highway, such as Yaupon Drive and Mitchell Drive, prevent through travel. The official event traffic control plan provides no rationale for or location of these barricades. However, they render travel in the area even more confusing and difficult.

Traffic Loop

Beginning at 10:00pm each Bikefest evening, and continuing nominally until 2:00am, Myrtle Beach implements a traffic loop plan. Prior to the 10:00pm kickoff, personnel align the pre-positioned traffic barricades to confine traffic within the loop, with access and egress at a limited number of points.

South of 29th Avenue North, the city closes all intersection approaches to Ocean Boulevard. Southbound through vehicles must remain on the boulevard to its end at Kings Highway. With the northbound traffic reserved for police and emergency vehicles, the boulevard remains one-way southbound.

Loop traffic flows in a clockwise direction. The loop channels motorists from Ocean Boulevard onto Kings Highway northbound, then west on Harrelson Boulevard/Bishop Parkway, north on Waccamaw Boulevard to Dick Scobee Drive, then north on US-501. Traffic may exit the loop at this point. To continue, the loop follows the Carolina Bays Parkway (SC-31) northbound to the Robert M. Grissom Parkway exit, follows Grissom Parkway to US-17 Bypass, travels south on the bypass to 29th Avenue North, and returns to Ocean Boulevard via this street. The complete route, shown in Figure 2, is just over 23 miles. With minimal traffic present, a complete circuit requires about 60 minutes.

The city modifies road operation as needed to accommodate the loop pattern. Between US-17 Bypass and Ocean Boulevard, 29th Avenue North handles eastbound traffic only. Some roads remain two-way, with barricades separating loop and non-loop directions. The eastbound Harrelson Boulevard lanes and connecting southbound Kings Highway lanes, for example, serve the airport via a contraflow "mini-loop." Carolina Bays Parkway, Grissom Parkway, and US-17 Bypass remain essentially unaltered, with loop and non-loop traffic mixed.

The main loop entry point is at the intersection of US-17 Bypass and 29th Avenue North. Drivers must travel southbound on the bypass to be permitted to turn east onto 29th Avenue North; northbound vehicles on the bypass may not enter the loop. Vehicles either northbound or southbound on Kings Highway may turn onto the loop at 29th Avenue North. Finally, southbound vehicles on Kings Highway are channeled into the loop at Harrelson Boulevard. Dashed yellow lines in Figure 2 denote the entry points.

Drivers may exit the loop only at locations shown in solid yellow in Figure 2. From Ocean Boulevard at 29th Avenue North, the first exit point at SC-31 is nearly 14 miles away. Beyond this point, drivers in the loop are relatively unrestricted until they re-enter 29th Avenue North from US-17 Bypass.

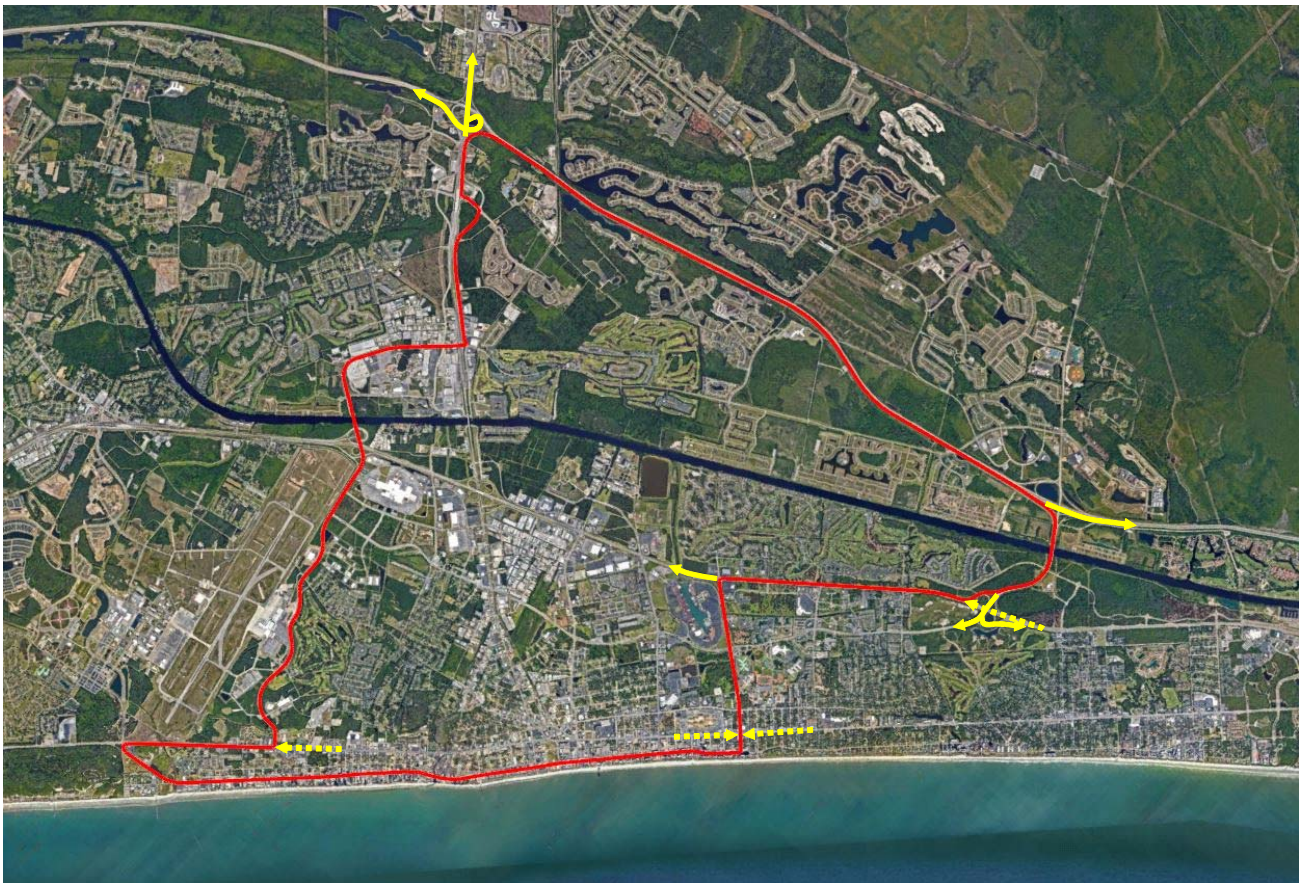


Figure 2. Traffic Loop

Between the initial entry point and the first exit point at SC-31, barricades prevent U-turns and turns at intersecting streets. Police officers stationed along the route ensure that motorists keep moving, obey traffic laws, and do not remove or drive around barricades.

During loop hours, employees and guests of establishments adjacent to access controlled loop lanes must use the loop to enter or exit the establishment. Center barricades block access to the non-loop lanes of two-way streets like Kings Highway. Drivers destined to the establishment have to traverse the loop from the closest upstream entry point, and those leaving must take the loop to the closest exit point.

While the loop pattern is scheduled to end at 2:00am, the city bases the actual time on traffic conditions. In 2018, light traffic led to early termination on several mornings.

Harley Week and Other Summer Weekends

During Harley Week in 2017 and 2018, I observed that the City permits normal two-way operation along Ocean Boulevard between 29th Avenue North and Kings Highway, with the present single traffic lane in each direction. Access to and from Ocean Boulevard is largely unrestricted, with most connecting intersections operating normally. During Harley Week in 2018, the intersection of Ocean Boulevard and 12th Avenue North was closed. The intersections of the boulevard with 28th Avenue North and 27th Avenue North were posted for no through traffic. There are also "no through traffic" signs posted at Yaupon and on streets parallel to Ocean Boulevard; however, those signs are not enforced.

The City makes no special provisions for traffic on Kings Highway or any other road under its control. It stations additional officers at various points along Ocean Boulevard, presumably to maintain order and respond to incidents. The South Carolina Highway Patrol (SCHP) also increases operations in the area to

enforce traffic and criminal laws, promote efficient traffic flow, assist with crashes, and control crowds. At locations throughout the area, SCHP deploys changeable message signs warning drivers of congestion and promoting alternate routes. Highway advisory radio also alerts drivers to incidents and advises alternate routes.

I understand that similarly minimal restrictions were in place for Harley Week for several years, including 2015 and 2016. In addition, the same basic traffic plan is used for busy summer weekend in Myrtle Beach, including the Sun Fun Festival, Fourth of July weekend, and Labor Day weekend.

Basis for the Bikefest Traffic Plan

Despite its tourist oriented economy, Myrtle Beach has a history of attempts to restrict motorcycle rallies. These large events, which attract several hundred thousand attendees to the Grand Strand area in peak years, inevitably increase both traffic accident and crime statistics, though whether the numbers reflect increased crime rates is unclear.

In the period 2001-2003, Ocean Boulevard operated under city-imposed traffic control plans during both Harley Week and Bikefest. Though the events were similar, the plans were distinctly different. As the Bikefest plan resulted in major inconvenience and traffic congestion compared with the Harley plan, African-American community leaders raised charges of discrimination. Following subsequent court rulings, Myrtle Beach ceased using the alternate plan for Bikefest.

Over Memorial Day weekend of 2008, a Coastal Carolina University student was fatally shot during a confrontation about a parking spot. Bikers were reportedly not involved, but the city passed ordinances restricting muffler noise, loitering in downtown parking lots, and vendors within city limits, as well as requiring helmets on motorcycle riders. Clearly targeted towards motorcycle events, many of these were subsequently reversed by court rulings. While the ordinances were in effect, many Harley Week attendees avoided Myrtle Beach, though Bikefest attendees continued to visit the city.

In 2014, three persons were fatally shot and another injured at a hotel on Ocean Boulevard during Memorial Day weekend. Shootings wounded six other persons in separate incidents in Myrtle Beach. In an alleged effort to curb future occurrences of violence, the city allocated a reported $4.1 million towards a series of public safety measures. To manage and control traffic, the city purchased traffic cones and barrels, portable signs, message boards, and 9,600 pedestrian and vehicular barricades. Installation of an on-street surveillance camera system along 60 blocks of Ocean Boulevard, deployment of 200 police officer body cameras, establishment of a police command post on Ocean Boulevard, and funding for additional police officer support during Bikefest bolstered law enforcement capabilities.

In 2015, Myrtle Beach implemented the traffic control plan previously described for Bikefest. After four years, it remains unique to this event. The traffic loop is imposed on no other event in the city, nor are the one-way restrictions and limited access on Ocean Boulevard.

While violent events are tragic and require preventive measures, traffic plans are supposed to provide for the safe and efficient movement of traffic during special events that place heavy or unusual demands on the local transportation system. As will be shown, the Bikefest traffic plan certainly does not follow best practices for event planning, and hinders rather than expedites the flow of traffic.

Moreover, even if one credited the idea that a traffic plan could be used to address concerns regarding crime, I note that there is little statistical evidence that criminal activity during Bikefest uniquely warrants such a heavy-handed approach. For example, the city experienced six shootings around Easter weekend 2017 (three on Ocean Boulevard). Similarly, there were seven people injured in a shooting along Ocean

Boulevard during Father's Day weekend in 2017, which former Mayor McBride referred to as "the worst shooting in the city's history." However, the City has not put any special traffic plans in place during either Easter weekend or over Father's Day weekend. Moreover, in 2014 when the loop was first considered, robberies in Myrtle Beach were sharply down both annually and during the Memorial Day weekend. Thus, there are serious questions surrounding the purported bases for the traffic plan put in place during Bikefest.

In this litigation, the City has indicated that it was motivated to put the one-way traffic pattern in place in order to provide emergency access to Ocean Boulevard. For the reasons discussed further below, there are also serious questions regarding whether the one-way traffic pattern is necessary to provide effective emergency access (and whether there are any substantial differences in traffic that would affect emergency access) during Memorial Day Weekend.

Traffic Planning for Special Events

There is a well-developed field of study around traffic planning for special events. Planned special events affect the transportation system in two ways. First, the attendees increase demand above the normal levels. Second, the event may reduce capacity by requiring the closure or modification of certain transportation system components. In Myrtle Beach, the relevant transportation system consists of the host community roads and streets, sidewalks, other bicycle and pedestrian facilities, and associated parking (on-street and off-street).

The Federal Highway Administration (FHWA) publication Managing Travel for Planned Special Events (FHWA 2003) is an excellent reference on the subject of managing traffic at large events such as motorcycle rallies. The publication characterizes planned special events as activities that occur at a known time and location(s) and have operating characteristics that affect the local transportation system. It specifically includes a motorcycle rally as a special event type.

The Myrtle Beach motorcycle rallies fit the FHWA category of Regional/Multi-venue Events, with theme activities scattered over multiple regional venues during the event period. Regional/Multi-venue Events may have concurrent activities taking place within the area. Activities may also occur sequentially, though at different locations, during the event period. The planning exercise must consider the location, timing, and attendee characteristics for each event component when analyzing traffic demands and impacts. Individual activities may fall into the category of Discrete/Recurring Event at a Permanent Venue, Street Use Event, or Continuous Event.

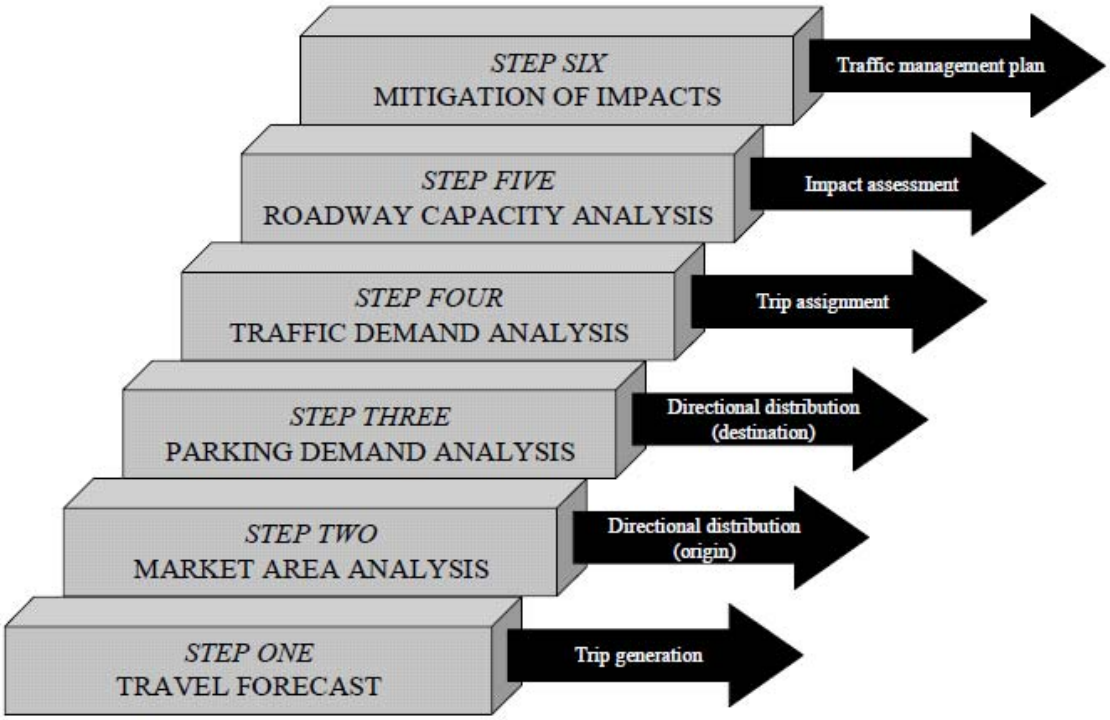
Regardless of the type, special events may affect mobility, travel time reliability, and traffic safety in and around the venue(s). Minimizing these impacts to event attendees and the local population should be a goal of event stakeholders, including local agencies. One of the key goals in event planning per the FHWA report is to ensure that the transportation system operates:

> *"…in a manner that fulfills the customer service requirements of event patrons and other road users during a planned special event."*

A planning process should seek to minimize delay and maximize highway safety for event attendees. It must also consider and maintain the travel needs of community residents and businesses not involved in the event.

Figure 3 shows the sequence of steps FHWA recommends in evaluating event traffic demands and developing mitigating strategies. Table 1 provides more detail on the activities and outputs of the steps.

Data collection is essential to evaluating potential event impacts and developing an appropriate plan. Planners need to assess specific event characteristics, including type, attendance, location, and sequence of activities, and then determine how these affect transportation system capacity. Data falls into two categories:



Source: Managing Travel for Planned Special Events, FHWA 2003

Figure 3. Event Traffic Planning Steps

Table 1. Event Traffic Planning Component Breakdown

Feasibility Study Analysis Summary

COMPONENT	ANALYSIS	RESULT	APPLICATION
Travel forecast	• Modal split	• Number of trips by mode of travel	• Input into parking demand analysis. • Input into traffic demand analysis.
	• Event traffic generation	• Number of vehicle trips by personal automobile	
	• Traffic arrival rate	• Number of trips per unit of time	
Market area analysis	• Event trip origin	• Geographic location of event trip origins and percent split	• Input into traffic demand analysis.
Parking demand analysis	• Background parking occupancy	• Number of non-attendee vehicles per parking area and unit of time	• Input into event parking occupancy.
	• Event parking demand	• Number of event-generated vehicles per parking area and unit of time	• Input into traffic demand analysis.
Traffic demand analysis	• Background traffic flow	• Background traffic demand rate, adjusted for event-required road closures	• Input into roadway capacity analysis.
	• Event traffic assignment	• Event traffic demand rate per assigned route	
Roadway capacity analysis	• Section and point capacity	• Identification of capacity constraints and level of service	• Input into traffic management plan. • Input into travel demand management assessment.
	• Network operations	• Identification of bottleneck locations and saturation flow rates	

Source: Managing Travel for Planned Special Events, FHWA 2003

supply and demand. Supply data encompasses the physical and operational characteristics of the transportation system affected by the event. Such data are needed to determine the operational performance of streets, bicycle/pedestrian facilities, and parking sites. Demand data reflects the volume and temporal patterns of event attendees. To evaluate transportation system impacts, planners need data on attendee numbers, their arrival and departure rates, and the split of transport modes used. Non-event transport system users and their travel patterns also need to be accounted for.

Given data, a transportation planner can employ various analytical tools to evaluate the behavior of the transportation system under the demands anticipated during the event period. This analysis will provide metrics describing the performance of various system components. Where the performance appears to be unacceptable, the planner will develop and test strategies to mitigate event related impacts. Such analysis is well understood by the transportation planning community, and there are standard methodologies and tools available.

Event traffic plans must provide for contingencies. FHWA advises:

> *"No planned special event transportation management plan, not even for a repeated special event, can be prepared and executed without detailed planning and without modifications as the event unfolds. To be successful, the event planning team has to anticipate, and therefore plan for, all the possible scenarios that will challenge the transportation network and the mobility of the plan."*

The transportation system behavior envisioned in a traffic plan is based upon a specific supply/demand scenario. Unexpected occurrences may invalidate the base assumptions, resulting in unacceptable system performance and negative impressions from event patrons and local citizens. Accordingly, good planning practice develops alternative scenarios that address possible disruptions occurring before or during the event. These may be related to weather effects; security threats; changes in the event (e.g., attendance, delay, or cancellation); riots, protests or demonstrations; and personnel or equipment shortages. Planners should also consider a scenario where the original plan is not working as envisioned without a disruptive influence.

For each contingency scenario, a successful plan must outline a well-reasoned and specific set of modifications to the basic plan. All personnel must be trained and equipped for their roles and responsibilities under each alternate scenario. As the event unfolds, the command center overseeing the traffic plan must be vigilant for circumstances that warrant implementing a contingency. Command personnel must maintain contact with field personnel to stay abreast of conditions, monitor the degree to which the plan is actually working, and be prepared to implement contingency measures as warranted.

Myrtle Beach Approach to Event Traffic Planning

The City of Myrtle Beach prepared a detailed plan for traffic and pedestrian management during Bikefest, particularly along Ocean Boulevard, but also including the aforementioned traffic loop. In doing so, however, the city did not employ principles outlined as best practices in publications such as Managing Travel for Planned Special Events (FHWA 2003). Were this to be the case, as actual data will show, Harley Week and Bikefest would be managed in similar fashion.

Of note, the City has not referenced the standard traffic-planning FHWA manual, but instead references National Special Security Events: Transportation Planning for Planned Special Events (FHWA 2011), another FHWA publication, as a basis for its plan. This document addresses planning for National Special Security Events (NSSE), a category that includes national political conventions, presidential inaugurations, major sports events, major international meetings, and state funerals. The primary focus of this document is

on maintaining security at these high-profile events. Indeed, because of the attractiveness of these events to organized protest groups and as targets for terrorism, security tends to outweigh inconvenience to the non-attendee public. Further, the document defines the primary role of law enforcement during an NSSE as support to the United States Secret Service in implementing security operations. The City has failed to explain why the Bikefest weekend, which does not attract significantly more visitors to the Myrtle Beach area than other busy summer weekend, requires the same security level as a Super Bowl or an Inauguration.

Indeed, observation of the plan implemented for Bikefest reveals that traffic flow, along with the visitor experience, is greatly degraded by the plan implemented. Traffic operations are better overall during Harley Week and other peak periods where no formal plan is in effect. This is likely because the city did not follow FHWA 2003 guidance in determining and mitigating transportation impacts in developing the Bikefest plan. Despite the many years that Bikefest and other busy summer weekends have brought large crowds to Myrtle Beach, the City has identified no quantitative data it has ever relied on to meaningfully evaluate whether and how traffic amounts or patterns during these weekends are different, whether emergency access response times are different, or whether there are any other differences which would affect the determination of an effective traffic plan.

Event Data

The traffic data team was assembled to evaluate traffic conditions at points along Ocean Boulevard and the traffic loop during the two motorcycle events in 2017 and 2018, along with selected other periods. Team members were trained and equipped to collect traffic counts, measure speeds, and take photographs and video. This section outlines the data assembled for the study.

Manual Traffic Counts

Vehicle count data is extremely useful in evaluating roadway operations. Count data is typically collected by direction of movement at 5-minute intervals, broken down by vehicle type. For intersections, approach movement volume (right turn, through movement, left turn) is recorded.

During 2017 and 2018 events, team members counted traffic manually, recording information on data sheets. Motorcycles and related vehicles (e.g., trikes, golf carts) were tallied separately from automobiles and trucks. Count periods ranged up to two hours, and were scheduled at various times of the weekend evening when traffic is typically heavy on downtown streets in Myrtle Beach.

In 2017, count teams were stationed along Ocean Boulevard at 29th Avenue North, 9th Avenue North, 8th Avenue North, 6th Avenue South, and Kings Highway. Team members counted traffic on Ocean Boulevard at these locations. At various times during Harley Week, team members counted traffic on the cross streets. Additional counts during Bikefest measured turning movements onto 29th Avenue North from Kings Highway and US-17 Bypass.

In 2018, counters primarily focused on measuring traffic flow along Ocean Boulevard. Teams were stationed at 8th Avenue North and 6th Avenue South to provide points of comparison. Records were made during the Friday and Saturday of both bike rallies, the first weekend of June, July 4th weekend, and Labor Day weekend. During Bikefest, a count team also monitored traffic entering the loop at the intersection of Kings Highway and 29th Avenue North.

Automated Hourly Count Data

Following the event, the team also retrieved data on hourly traffic flows at several locations in the Myrtle Beach area. The South Carolina Department of Transportation collects this data at continuous count stations

and makes it available in near real-time on a web site. Figure 4 shows the locations of count stations in the Myrtle Beach area, which bracket major roads leading into the city. While none are on Ocean Boulevard or Kings Highway in downtown, the station counts provide a reference for comparing various events.

Probe Vehicle Measurements

Several team members drove vehicles along Ocean Boulevard and other streets, including the traffic loop. Each vehicle contained a data logger equipped with a Global Positioning System (GPS) receiver. The devices continuously recorded vehicle location, date, time of day, and speed at one-second intervals. These probe vehicles provided information reflecting actual travel conditions during the events. Two probe vehicles operated during the 2017 motorcycle rally weekends. For 2018, the number increased to six during such weekends. A single vehicle operated during the other weekends surveyed in 2018.

Photographs and Videos

During both of the motorcycle rallies in 2017 and 2018, the team recorded traffic and roadway conditions for later study using photographs and videotape. Videotape was taken both from vehicles in the traffic stream and while walking along Ocean Boulevard.

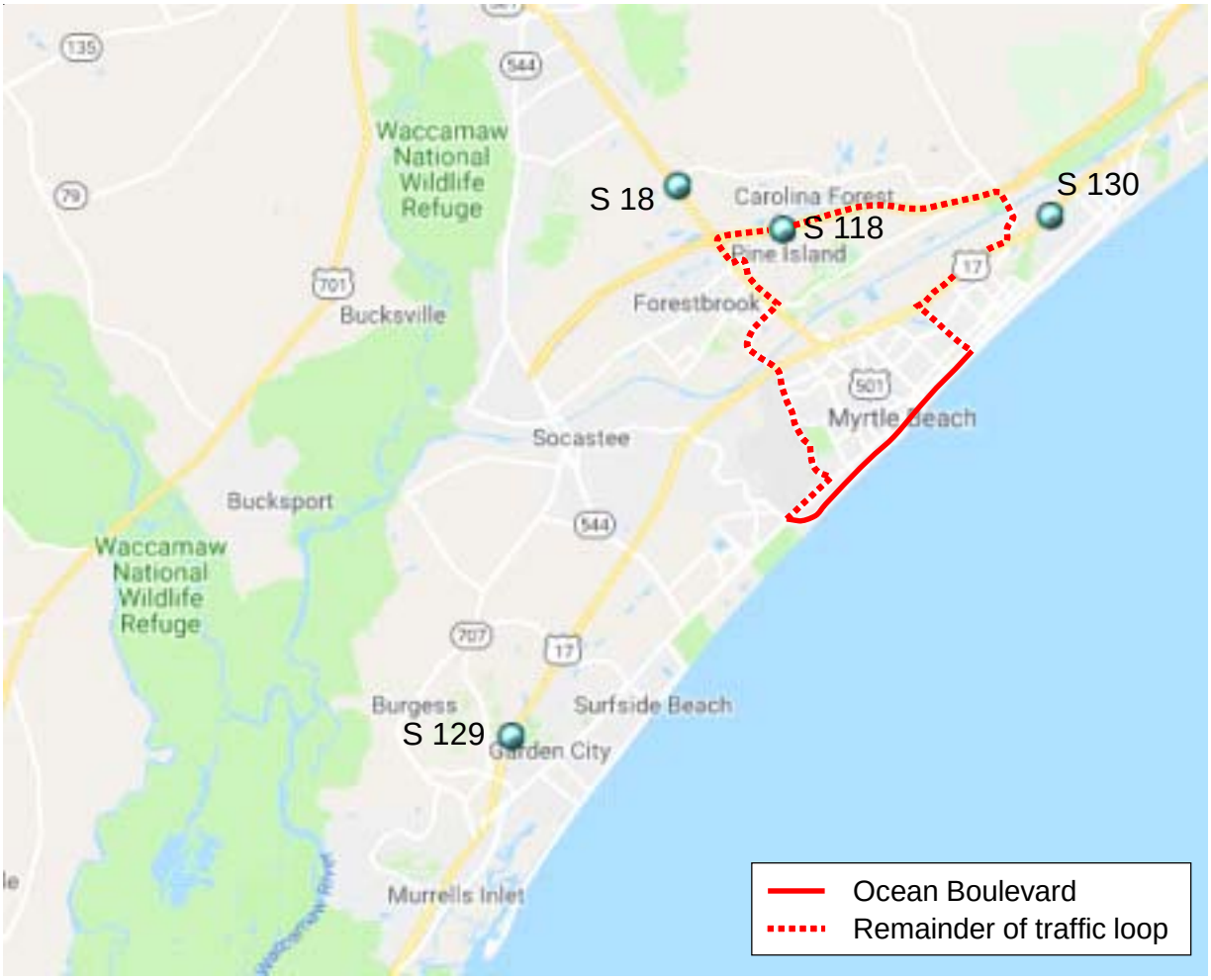


Figure 4. SCDOT Count Station Locations

Hotel Occupancy

The Center for Resort Tourism at Coastal Carolina University conducts weekly surveys of occupancy at hotels, condo-hotels, and campgrounds along South Carolina's Grand Strand. This provides some measure of visitors in the area for short duration stays. While the area also contains a sizable number of vacation rental properties, these typically rent for one-week periods, making them less attractive to attendees of short term events.

Other Observations

During their daily assignment, team members recorded on log sheets observations on the roadway environment, traffic and pedestrian behavior, and law enforcement. In 2018, team members also walked along Ocean Boulevard to assess traffic controls in place during the events.

Comparison of Traffic Demand During Events

For Bikefest to have a restrictive traffic plan, particularly compared with the minimal treatment afforded Harley Week and other events in the Myrtle Beach area, there have to be demonstrated differences in traffic demand that impact local roadways more severely. The traffic plan should then attempt to accommodate the event flow in a manner that provides the minimum overall impact.

Were Bikefest to have a much larger attendance and significantly more traffic demands than other busy weekends, a different traffic plan might be warranted. Myrtle Beach planners present no evidence that this is the case. While neither event has a formal registration system to count participation, there is the experience of years to draw upon in comparing the event sizes. Media accounts agree that both events have attracted several hundred thousand to the Myrtle Beach area in peak years. However, there are no firm counts.

Lodging Occupancy

Lodging occupancy represents one measure to evaluate the relative attendance by non-residents at events in Myrtle Beach. Table 2 presents data on occupancy rates along the Grand Strand during various events, including the motorcycle rallies, between 2012 and 2018. In no single year does Bikefest reflect the highest occupancy rate. Since 2015, Harley Week has had higher occupancy rates than Bikefest. While occupancy rates do not reflect the number of occupants per room, which is relevant to overall attendance, there is no evidence to indicate differences between the events. Moreover, many establishments limit the number of

Table 2. Grand Strand Occupancy Rates: 2012-2018

	Easter	First weekend May	Harley	Bikefest	First weekend June	Last weekend June	July 4th	Last weekend July	First weekend Aug.	Labor Day
2018	80.4%	80.2%	79.4%	77.7%	71.0%	92.7%	83.9%	96.0%	N/A	85.9%
2017	90.1%	82.3%	89.5%	78.8%	84.4%	84.7%	83.8%	90.6%	87.6%	76.5%
2016	N/A	N/A	88.3%	82.5%	N/A	96.0%	93.1%	N/A	95.8%	82.8%
2015	84.4%	76.1%	86.4%	86.0%	88.0%	N/A	93.8%	97.3%	97.0%	86.0%
2014	76.8%	61.5%	80.0%	81.6%	80.9%	88.1%	N/A	93.2%	91.8%	88.5%
2013	75.2%	56.6%	77.8%	90.3%	68.6%	88.6%	91.5%	93.7%	93.7%	84.0%
2012	88.0%	62.6%	74.5%	84.0%	69.8%	83.8%	88.5%	92.1%	92.2%	79.7%

Figures reflect Grand Strand hotel, condo-hotel, and campsite occupancy estimate based on survey
Data from Clay J. Brittain Center for Resort Tourism, Coastal Carolina University
Source: https://www.coastal.edu/business/resort/archives/
N/A indicates data not available

motor vehicles per room, which is more important for traffic purposes. Overall, the occupancy rates reflect neither higher attendance nor motor vehicle numbers for Bikefest versus other events.

Daily Traffic

Traffic volume provides another measure of event attendance, and, obviously, traffic needs. An influx of visitors to an area increases daily traffic volumes, particularly on roads serving as primary access routes. This is especially likely for locations that are popular tourism destinations like Myrtle Beach.

The South Carolina Department of Transportation maintains a network of continuous traffic monitoring stations that count passing vehicles using sensors embedded in the pavement. Each hour, the station generates the total passing vehicle count by direction. Data is uploaded to the department's web site and made available on a near real-time basis. While the counting is intended to be continuous, gaps occur when the station is off-line or has technical problems. The data set does not provide any information on vehicle classification.

Figure 4 shows the location of four count stations surrounding Myrtle Beach. The stations on US-17 (S 129), US-17 Bypass (S 130), and US-501 (S 18) capture many trips destined to or passing through Myrtle Beach. The station at Carolina Bays Parkway (S 118) is included because it lies along the traffic loop.

Table 3 provides 48-hour count totals (Friday and Saturday) for various weekends in 2018, including the rallies. Sunday counts are not included because they appear universally smaller than Friday and Saturday. Total traffic past the stations during the non-rally weekends shown often exceeds that of either Harley weekend or Bikefest weekend. At no station does Bikefest traffic represent either the smallest or largest 48-hour total.

While 2017 data was unavailable for comparison of the various weekends, Table 4 provides the data for 2016 and Table 5 provides 2015 data. Prior years are unavailable via the SCDOT web site, and several stations lacked complete data for 2015 and 2016. As in 2018, Bikefest traffic represents neither the smallest nor largest 48-hour weekend total.

Table 6 provides the 48-hour counts just for the two motorcycle rallies. The significant difference is on US-17 Bypass, where Bikefest counts are 11.7% higher in 2017 and 9.9% higher in 2018. This likely reflects attendees traveling back and forth to Atlantic Beach, which this station is positioned to count. Since Atlantic Beach has little lodging capacity, most Bikefest attendees stay in surrounding communities. The other count stations do not show a uniform trend.

Based on these count data, at best Bikefest attendance may be a few percentage points higher than Harley Week. When compared with even higher traffic counts on other weekends, this does not support the need for a special Bikefest traffic plan.

Hourly Temporal Traffic Variation

Temporal variation in traffic flow might be another possible justification for the different event traffic plans. Figures 5 through 8 compare hourly count data for the two 2018 rally weekends comprising calendar days Friday through Sunday (72 total hours). The overall flow patterns are similar in shape and peak magnitude, with the exception of station 130 on US-17 Bypass. During Bikefest, the bypass shows overall heavier hourly volumes northbound during late afternoon and evening hours, and sharp peaks southbound, particularly after midnight. Again, this likely reflects travel from Myrtle Beach to points north, including Atlantic Beach, with the evening spikes representing return trips. Figures 9 and 10 demonstrate that this phenomenon also occurred during the period from 2015-2017.

Table 3. 2018 48-hour Count Totals

Site 18 US-501

2018 Vehicle Counts	Easter	First weekend in May	5/18-19 (Harley)	5/25-26 (Bikefest)	First weekend in June	Last weekend in June	July 4th	Last weekend in July	First weekend in August	Labor Day
Northbound	59936	60723	54484	53462	60526	62480	63064	59984	59790	57168
Southbound	56612	59096	51865	55711	58354	57148	54191	54179	54459	58718
Total	116548	119819	106349	109173	118880	119628	117255	114163	114249	115886
%Diff Harley	9.6%	12.7%	0.0%	2.7%	11.8%	12.5%	10.3%	7.3%	7.4%	9.0%
%Diff Bikefest	6.8%	9.8%	-2.6%	0.0%	8.9%	9.6%	7.4%	4.6%	4.6%	6.1%

Site 129 US-17

2018 Vehicle Counts	Easter	First weekend in May	5/18-19 (Harley)	5/25-26 (Bikefest)	First weekend in June	Last weekend in June	July 4th	Last weekend in July	First weekend in August	Labor Day
Northbound	38004	37729	37617	37637	39188	41944	43013	42385	42087	40451
Southbound	39008	39056	38169	39066	39290	42224	42507	43439	43645	41956
Total	77012	76785	75786	76703	78478	84168	85520	85824	85732	82407
%Diff Harley	1.6%	1.3%	0.0%	1.2%	3.6%	11.1%	12.8%	13.2%	13.1%	8.7%
%Diff Bikefest	0.4%	0.1%	-1.2%	0.0%	2.3%	9.7%	11.5%	11.9%	11.8%	7.4%

Site 130 US-17BP

2018 Vehicle Counts	Easter	First weekend in May	5/18-19 (Harley)	5/25-26 (Bikefest)	First weekend in June	Last weekend in June	July 4th	Last weekend in July	First weekend in August	Labor Day
Northbound	37891	36826	36227	38852	36101	40275	39921	40115	39680	37675
Southbound	36073	34763	34532	38280	34046	38631	39257	39400	38919	36006
Total	73964	71589	70759	77132	70147	78906	79178	79515	78599	73681
%Diff Harley	4.5%	1.2%	0.0%	9.0%	-0.9%	11.5%	11.9%	12.4%	11.1%	4.1%
%Diff Bikefest	-4.1%	-7.2%	-8.3%	0.0%	-9.1%	2.3%	2.7%	3.1%	1.9%	-4.5%

Site 118 SC-31

2018 Vehicle Counts	Easter	First weekend in May	5/18-19 (Harley)	5/25-26 (Bikefest)	First weekend in June	Last weekend in June	July 4th	Last weekend in July	First weekend in August	Labor Day
Northbound	25759	26496	25325	28435	26522	28653	28577	28400	N/A	26923
Southbound	28807	29666	29017	29111	29584	33510	32697	33003	N/A	32129
Total	54566	56162	54342	57546	56106	62163	61274	61403	-	59052
%Diff Harley	0.4%	3.3%	0.0%	5.9%	3.2%	14.4%	12.8%	13.0%	-	8.7%
%Diff Bikefest	-5.2%	-2.4%	-5.6%	0.0%	-2.5%	8.0%	6.5%	6.7%	-	2.6%

Notes: Counts cover calendar days Friday and Saturday.
Data from SCDOT continuous count stations

Table 4. 2016 48-hour Count Totals

Site 129 US-17

2016 Vehicle Counts	Easter	First weekend in May	5/20-21 (Harley)	5/27-28 (Bikefest)	First weekend in June	Last weekend in June	July 4th	Last weekend in July	First weekend in August	Labor Day
Northbound	35986	38202	39967	36813	38911	38812	39465	36705	39016	29738
Southbound	37555	38702	40670	37773	39155	39031	41786	40298	40898	31490
Total	73541	76904	80637	74586	78066	77843	81251	77003	79914	61228
%Diff Harley	-8.8%	-4.6%	0.0%	-7.5%	-3.2%	-3.5%	0.8%	-4.5%	-0.9%	-24.1%
%Diff Bikefest	-1.4%	3.1%	8.1%	0.0%	4.7%	4.4%	8.9%	3.2%	7.1%	-17.9%

Site 130 US-17BP

2016 Vehicle Counts	Easter	First weekend in May	5/20-21 (Harley)	5/27-28 (Bikefest)	First weekend in June	Last weekend in June	July 4th	Last weekend in July	First weekend in August	Labor Day
Northbound	36863	35944	37734	38381	36215	39063	40654	42180	41153	31094
Southbound	34285	33613	36230	38787	33903	36342	38272	39579	38735	28869
Total	71148	69557	73964	77168	70118	75405	78926	81759	79888	59963
%Diff Harley	-3.8%	-6.0%	0.0%	4.3%	-5.2%	1.9%	6.7%	10.5%	8.0%	-18.9%
%Diff Bikefest	-7.8%	-9.9%	-4.2%	0.0%	-9.1%	-2.3%	2.3%	5.9%	3.5%	-22.3%

Site 118 SC-31

2016 Vehicle Counts	Easter	First weekend in May	5/20-21 (Harley)	5/27-28 (Bikefest)	First weekend in June	Last weekend in June	July 4th	Last weekend in July	First weekend in August	Labor Day
Northbound	23432	24977	25556	27552	24459	25362	26563	28151	27256	20170
Southbound	25013	26150	26908	28054	25857	28150	30941	31206	31647	22138
Total	48445	51127	52464	55606	50316	53512	57504	59357	58903	42308
%Diff Harley	-7.7%	-2.5%	0.0%	6.0%	-4.1%	2.0%	9.6%	13.1%	12.3%	-19.4%
%Diff Bikefest	-12.9%	-8.1%	-5.7%	0.0%	-9.5%	-3.8%	3.4%	6.7%	5.9%	-23.9%

Notes: Counts cover calendar days Friday and Saturday.
Data from SCDOT continuous count stations
2016 data not available for US-501 monitoring station 18

Table 5. 2015 48-hour Count Totals

Site 129 US-17

2015 Vehicle Counts	Easter	First weekend in May	5/15-16 (Harley)	5/22-23 (Bikefest)	First weekend in June	Last weekend in June	July 4th	Last weekend in July	First weekend in August	Labor Day
Northbound	38493	37309	41933	36946	39227	39801	36245	40448	40536	37712
Southbound	39404	38001	43813	38876	40043	40266	37515	41486	41778	39433
Total	77897	75310	85746	75822	79270	80067	73760	81934	82314	77145
%Diff Harley	-9.2%	-12.2%	0.0%	-11.6%	-7.6%	-6.6%	-14.0%	-4.4%	-4.0%	-10.0%
%Diff Bikefest	2.7%	-0.7%	13.1%	0.0%	4.5%	5.6%	-2.7%	8.1%	8.6%	1.7%

Site 130 US-17BP

2015 Vehicle Counts	Easter	First weekend in May	5/15-16 (Harley)	5/22-23 (Bikefest)	First weekend in June	Last weekend in June	July 4th	Last weekend in July	First weekend in August	Labor Day
Northbound	36804	36195	40087	38964	38035	39653	38593	40937	41673	36118
Southbound	33695	33010	38041	37467	34281	36650	36223	38467	38890	33575
Total	70499	69205	78128	76431	72316	76303	74816	79404	80563	69693
%Diff Harley	-9.8%	-11.4%	0.0%	-2.2%	-7.4%	-2.3%	-4.2%	1.6%	3.1%	-10.8%
%Diff Bikefest	-7.8%	-9.5%	2.2%	0.0%	-5.4%	-0.2%	-2.1%	3.9%	5.4%	-8.8%

Notes: Counts cover calendar days Friday and Saturday.
Data from SCDOT continuous count stations
2015 data not available for US-501 monitoring station 18 and SC-31 monitoring station 118

Figure 11 compares the hourly volumes at station 130 for the three days of the weekend before the July 4th holiday in 2018 with Bikefest weekend. Other than the aforementioned late-night spikes, the hourly plots for the two weekends appear similar. Note that the July 4th weekend has the highest hourly volume.

In summary, available data lead to the conclusions that:

- Since 2012, occupancy rates during Bikefest at hotels and other venues for short term lodging do not differ significantly from other peak weekends during the year, including Harley Week. All indicate heavy visitor attendance along the Grand Strand.
- Since 2016, traffic counts at major roads leading to Myrtle Beach show that Bikefest weekend generates total vehicle volumes similar to other peak weekends during the year, including Harley Week.
- In 2018, the hourly traffic volume pattern for Bikefest weekend was similar to that of Harley Week and the weekend before July 4th weekend at three count stations. The fourth station, located on US-17 Bypass north of Myrtle Beach, showed differences that logically relate to the route's use to access Atlantic Beach, home of Bikefest.

Taken together, these conclusions indicate that differences in attendance or traffic characteristics do not justify a unique Bikefest traffic plan. Bikefest numbers are similar to other peak weekends during the year.

Demand for Ocean Boulevard Travel

The Bikefest plan, with its major changes to Ocean Boulevard and the notorious late hour loop, implies that Bikefest somehow affects Ocean Boulevard uniquely. However, there is no evidence to show that travel demand characteristics experienced during Bikefest are not present during any other period.

Table 6. Motorcycle Event 48-hour Counts by Year

Site 18 US-501

	2014		2015		2016		2017		2018	
Vehicle Counts	5/16-17 (Harley)	5/23-24 (Bikefest)	5/15-16 (Harley)	5/22-23 (Bikefest)	5/20-21 (Harley)	5/27-28 (Bikefest)	5/19-20 (Harley)	5/26-27 (Bikefest)	5/18-19 (Harley)	5/25-26 (Bikefest)
Northbound	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	59790	57168
Southbound	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	54459	58718
Total	-	-	-	-	-	-	-	-	114249	115886
%Diff Harley										1.4%

Site 129 US-17

	2014		2015		2016		2017		2018	
Vehicle Counts	5/16-17 (Harley)	5/23-24 (Bikefest)	5/15-16 (Harley)	5/22-23 (Bikefest)	5/20-21 (Harley)	5/27-28 (Bikefest)	5/19-20 (Harley)	5/26-27 (Bikefest)	5/18-19 (Harley)	5/25-26 (Bikefest)
Northbound	N/A	N/A	40087	38964	39967	36813	N/A	N/A	37617	37637
Southbound	N/A	N/A	38041	37467	40670	37773	N/A	N/A	38169	39066
Total	-	-	78128	76431	80637	74586	-	-	75786	76703
%Diff Harley				-2.2%		-7.5%				1.2%

Site 130 US-17BP

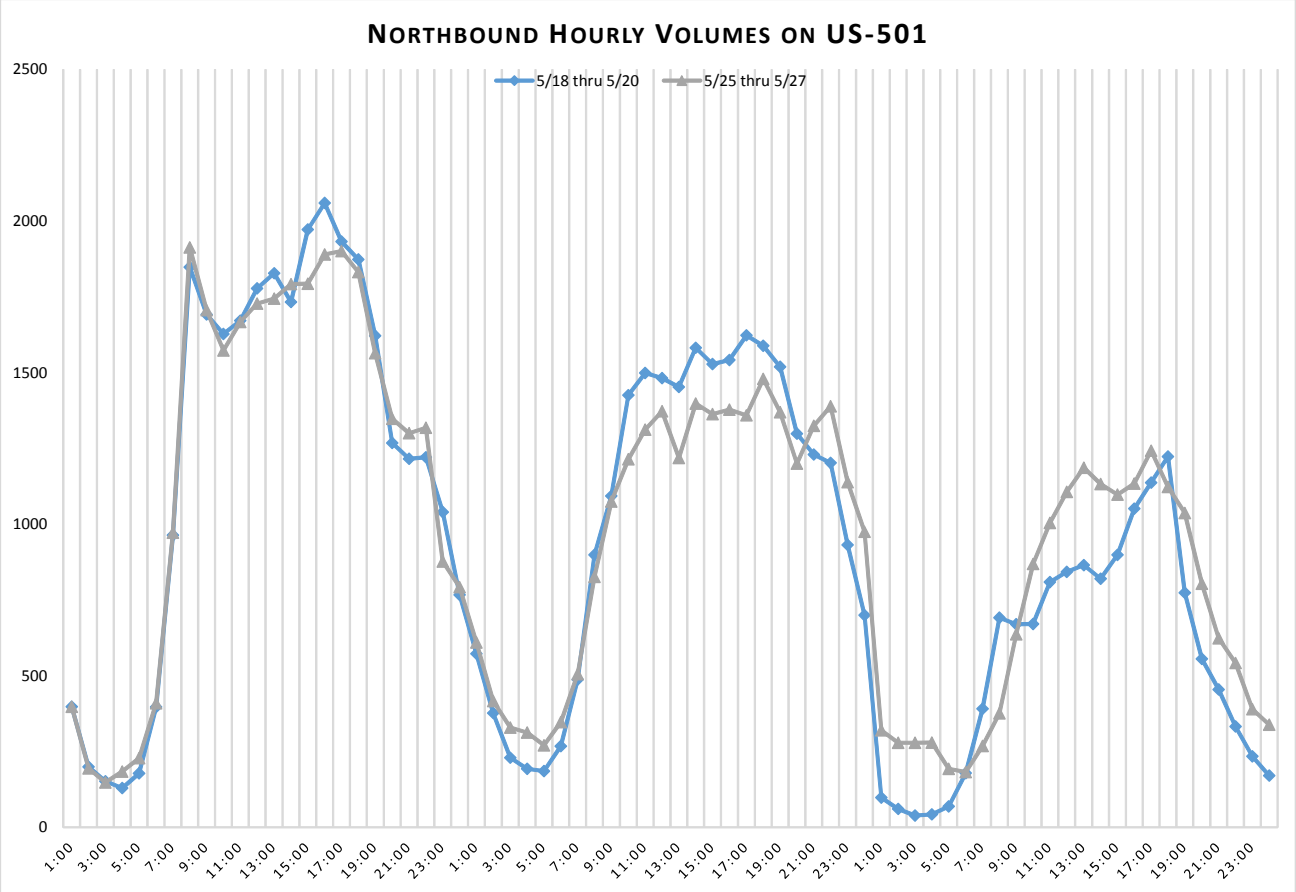
	2014		2015		2016		2017		2018	
Vehicle Counts	5/16-17 (Harley)	5/23-24 (Bikefest)	5/15-16 (Harley)	5/22-23 (Bikefest)	5/20-21 (Harley)	5/27-28 (Bikefest)	5/19-20 (Harley)	5/26-27 (Bikefest)	5/18-19 (Harley)	5/25-26 (Bikefest)
Northbound	N/A	N/A	40087	38964	37734	38381	32746	38089	36227	38852
Southbound	N/A	N/A	38041	37467	36230	38787	37304	40148	34532	38280
Total	-	-	78128	76431	73964	77168	70050	78237	70759	77132
%Diff Harley				-2.2%		4.3%		11.7%		9.0%

Site 118 SC-31

	2014		2015		2016		2017		2018	
Vehicle Counts	5/16-17 (Harley)	5/23-24 (Bikefest)	5/15-16 (Harley)	5/22-23 (Bikefest)	5/20-21 (Harley)	5/27-28 (Bikefest)	5/19* (Harley)	5/26* (Bikefest)	5/18-19 (Harley)	5/25-26 (Bikefest)
Northbound	26183	26087	N/A	N/A	25556	27552	15827	15196	25325	28435
Southbound	26138	25943	N/A	N/A	26908	28054	17291	16892	29017	29111
Total	52321	52030	-	-	52464	55606	33118	32088	54342	57546
%Diff Harley		-0.6%				6.0%		-3.1%		5.9%

Notes: Counts cover calendar days Friday and Saturday, unless noted.
Data from SCDOT continuous count stations
* Data covers Friday only
N/A indicates data not available

Figure 5. 2018 Motorcycle Event 72-hour Counts, Station 18 (US-501)



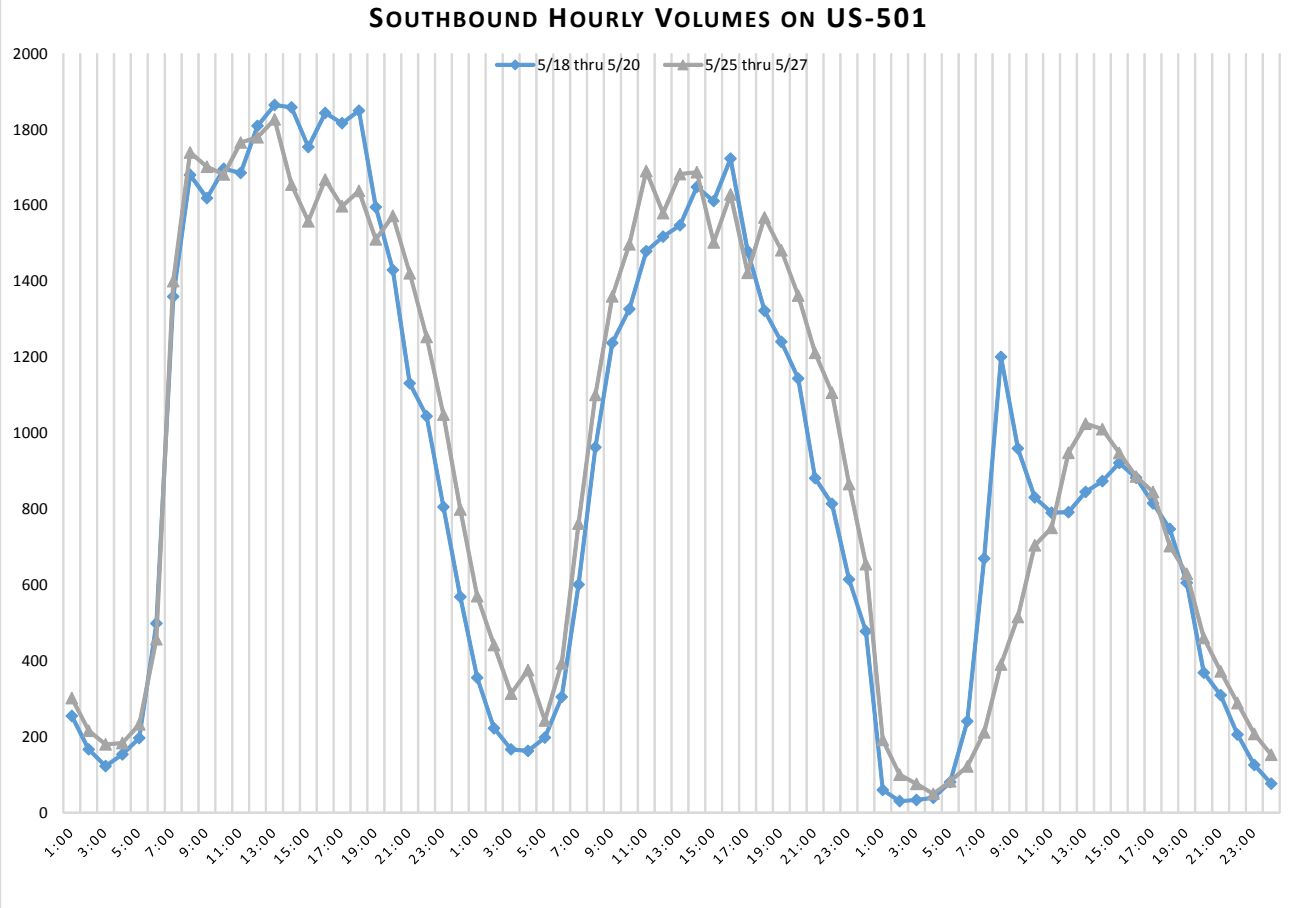
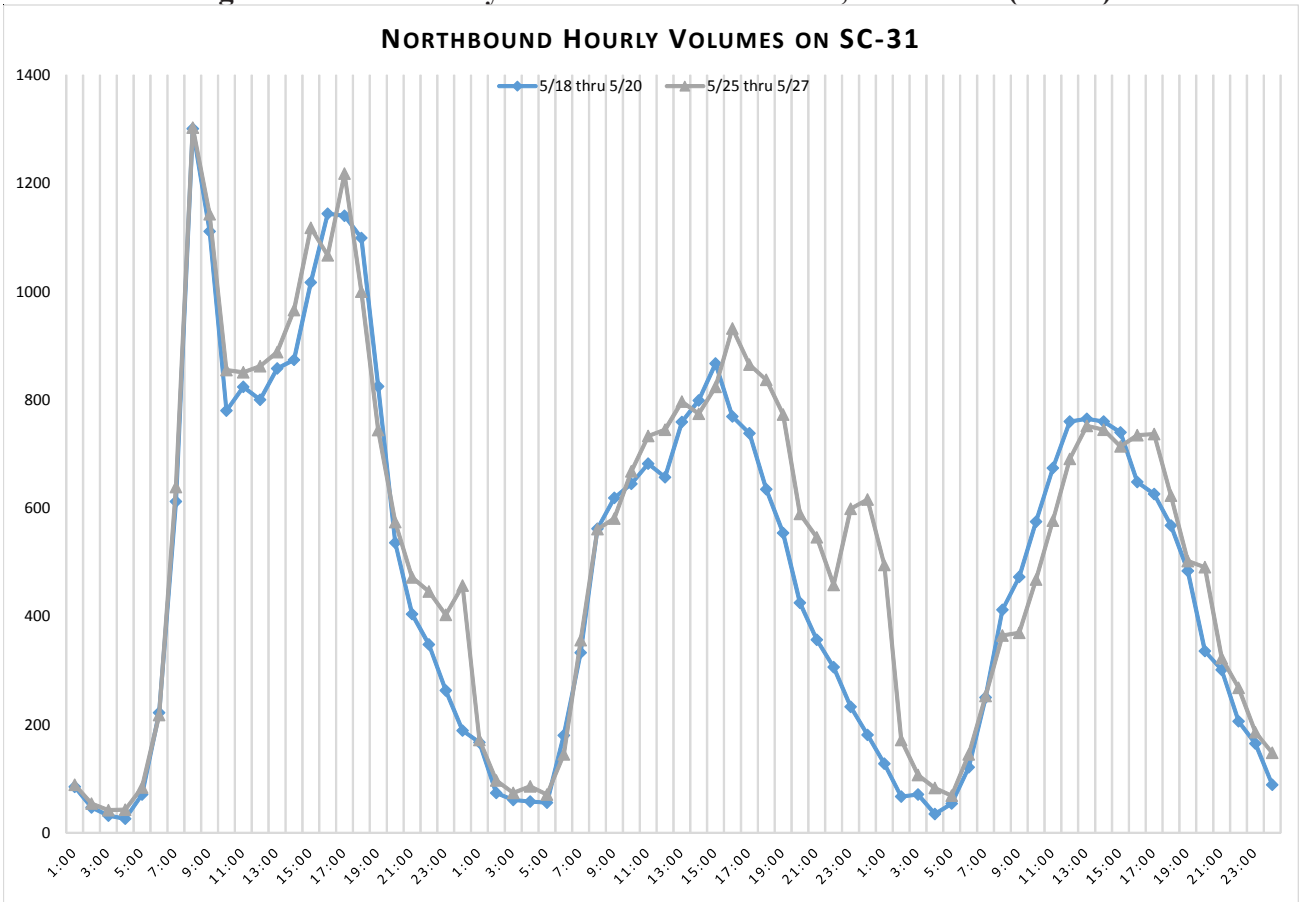


Figure 6. 2018 Motorcycle Event 72-hour Counts, Station 118 (SC-31)



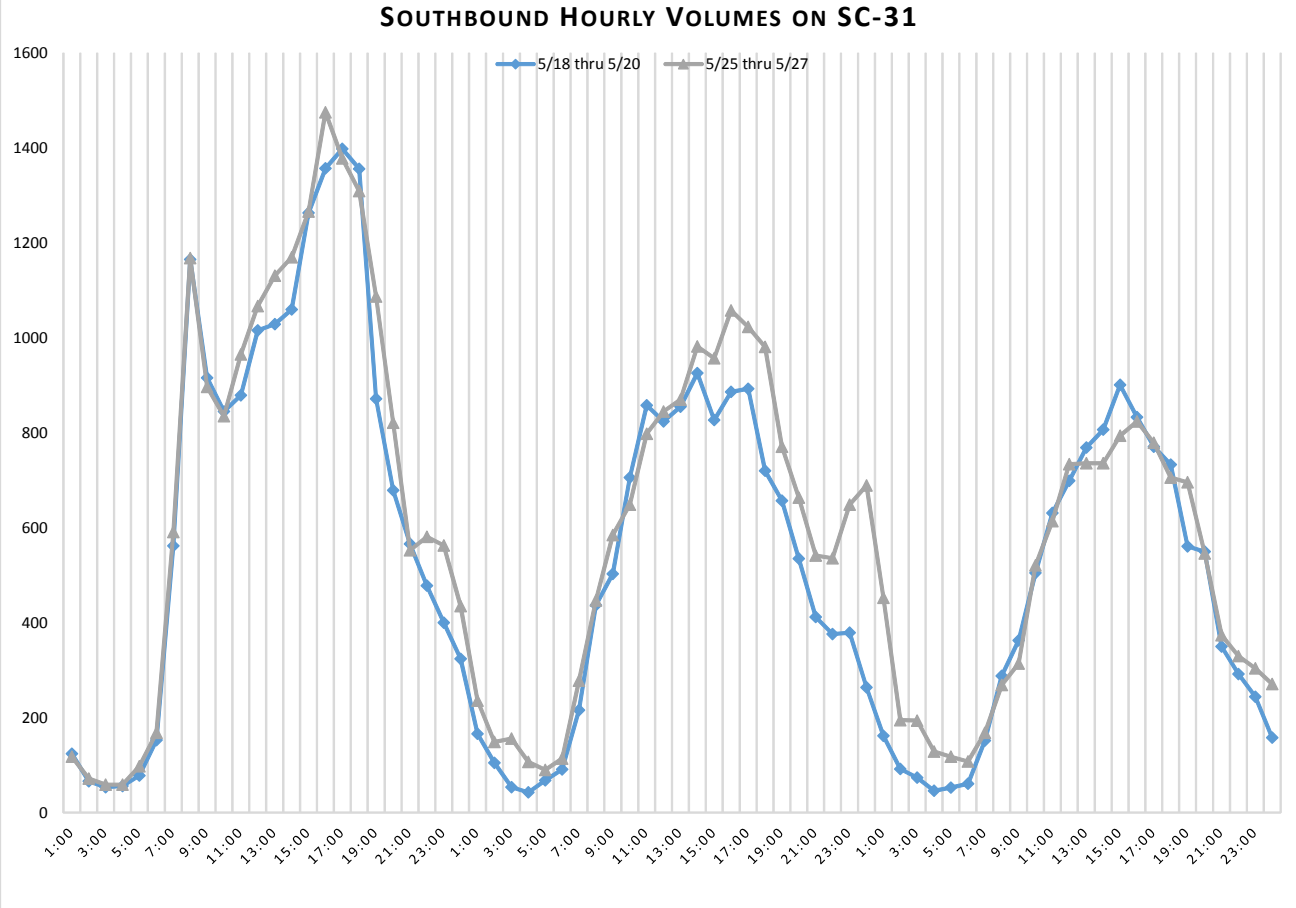
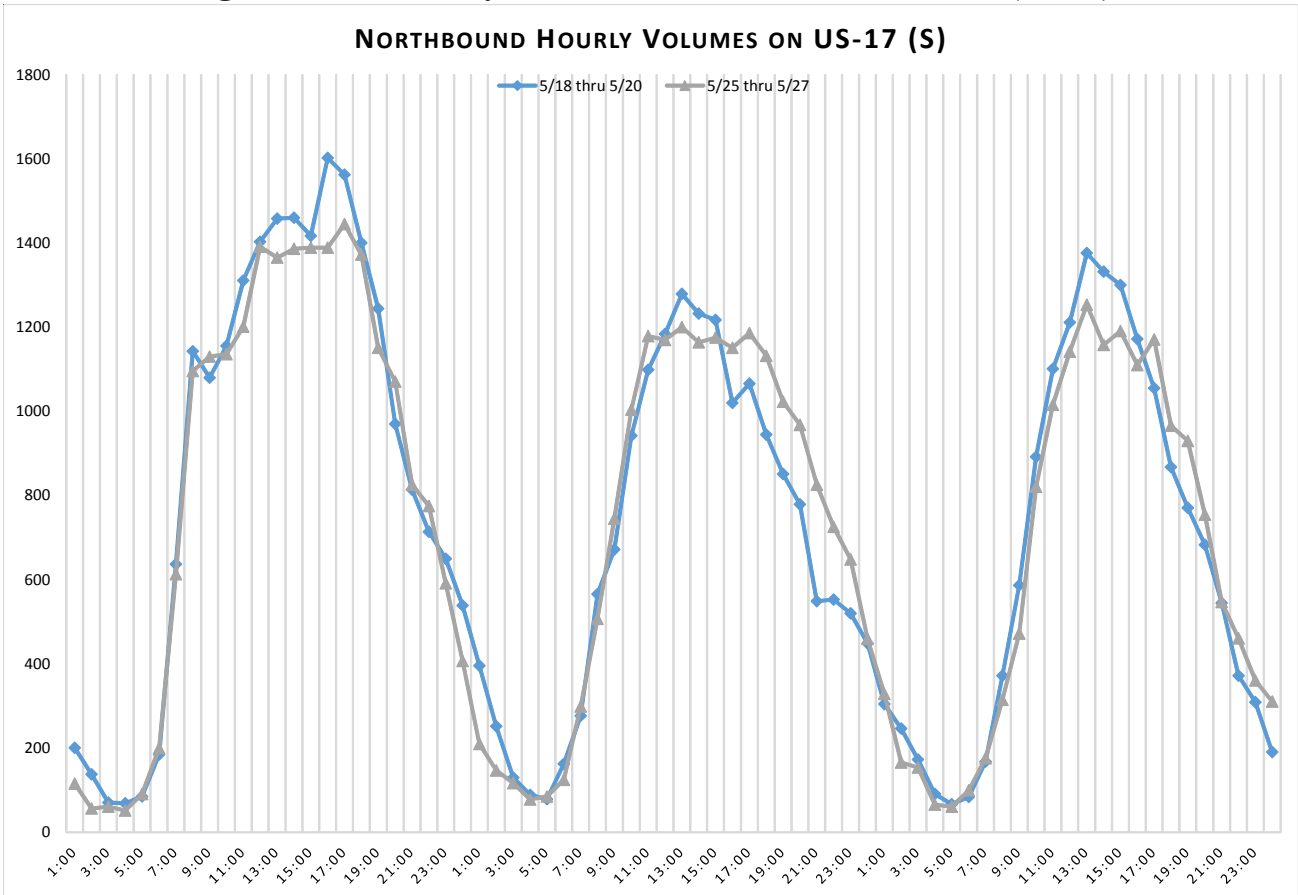


Figure 7. 2018 Motorcycle Event 72-hour Counts, Station 129 (US-17)



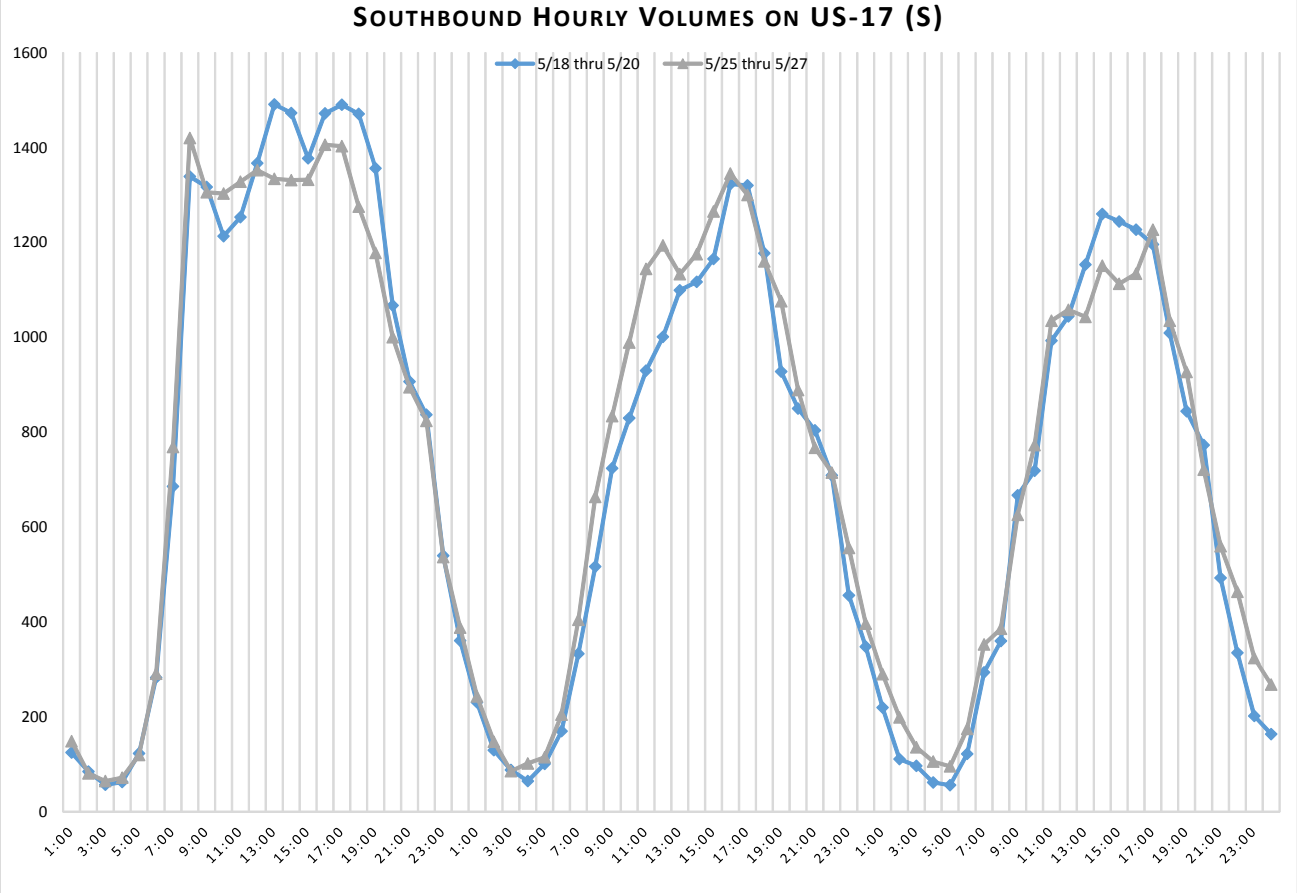
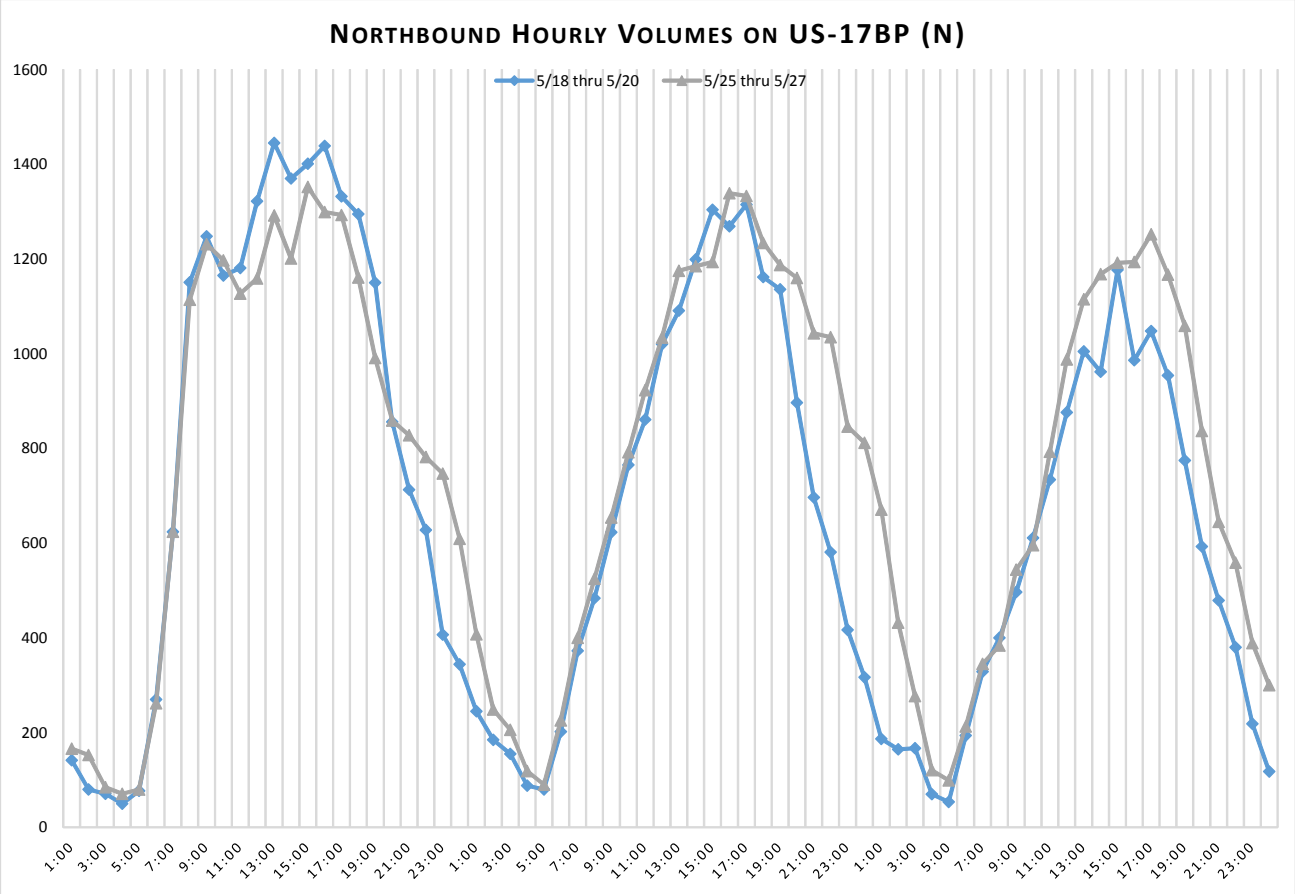


Figure 8. 2018 Motorcycle Event 72-hour Counts, Station 130 (US-17 Bypass)



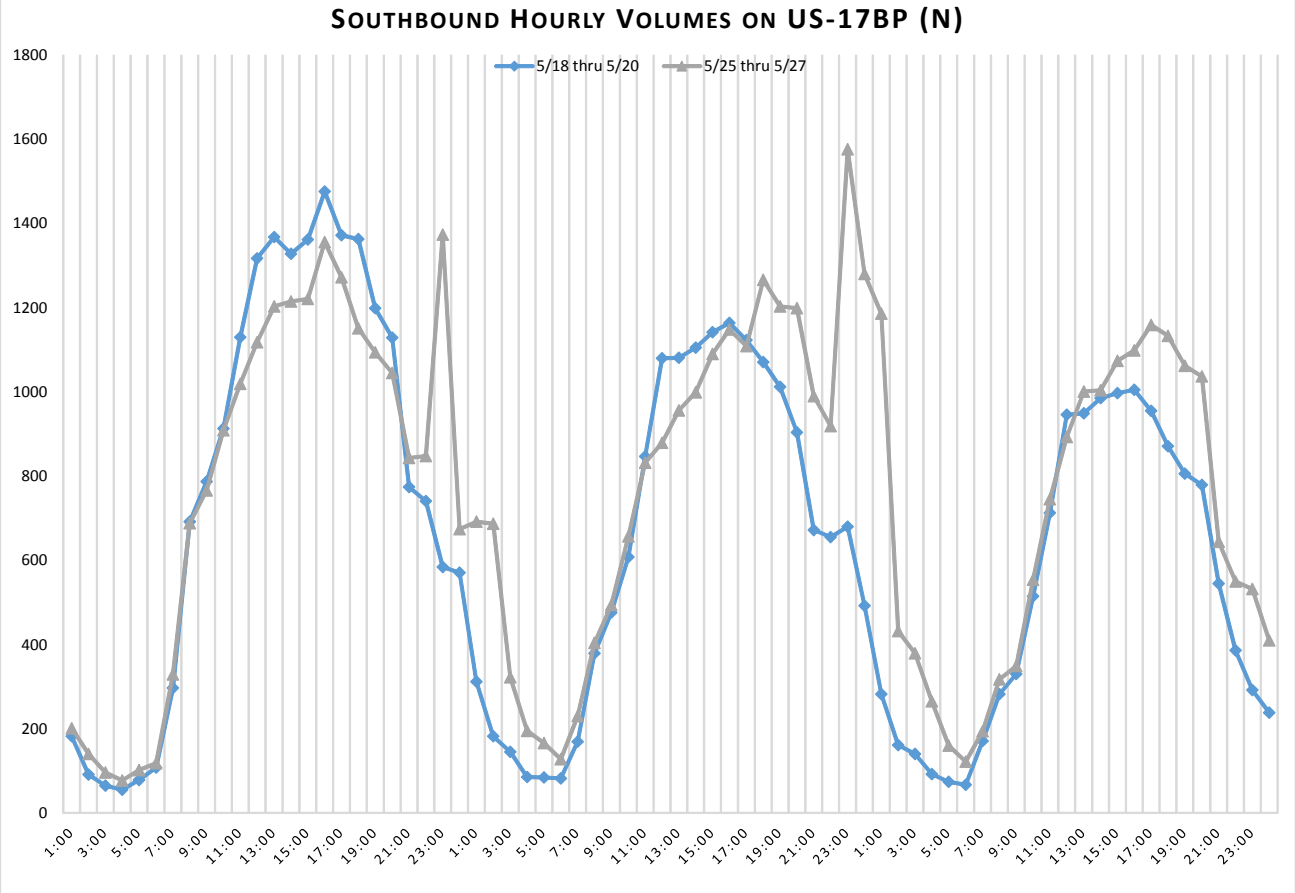
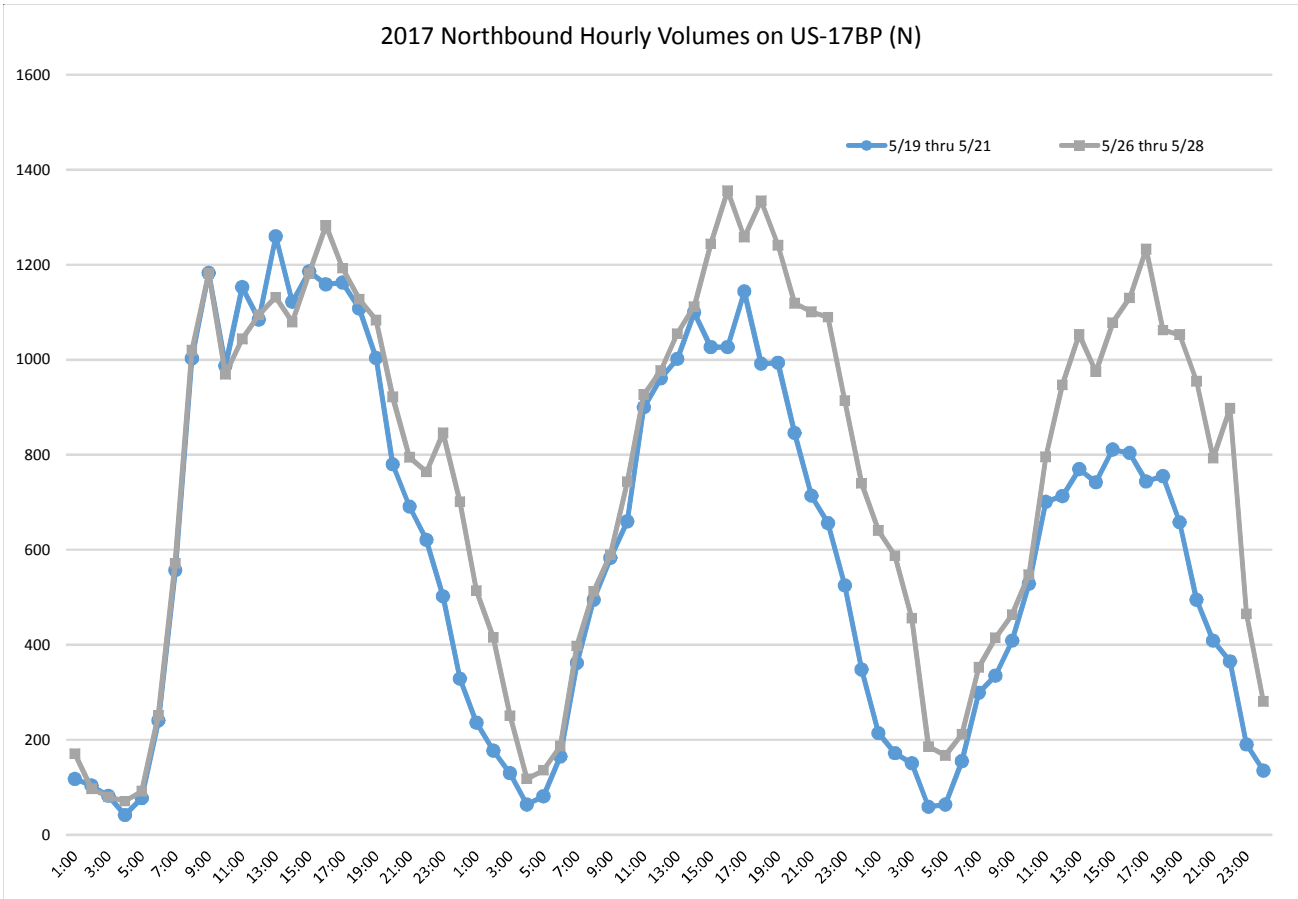


Figure 9. 2017 Motorcycle Event 72-hour Counts, Station 130 (US-17 Bypass)



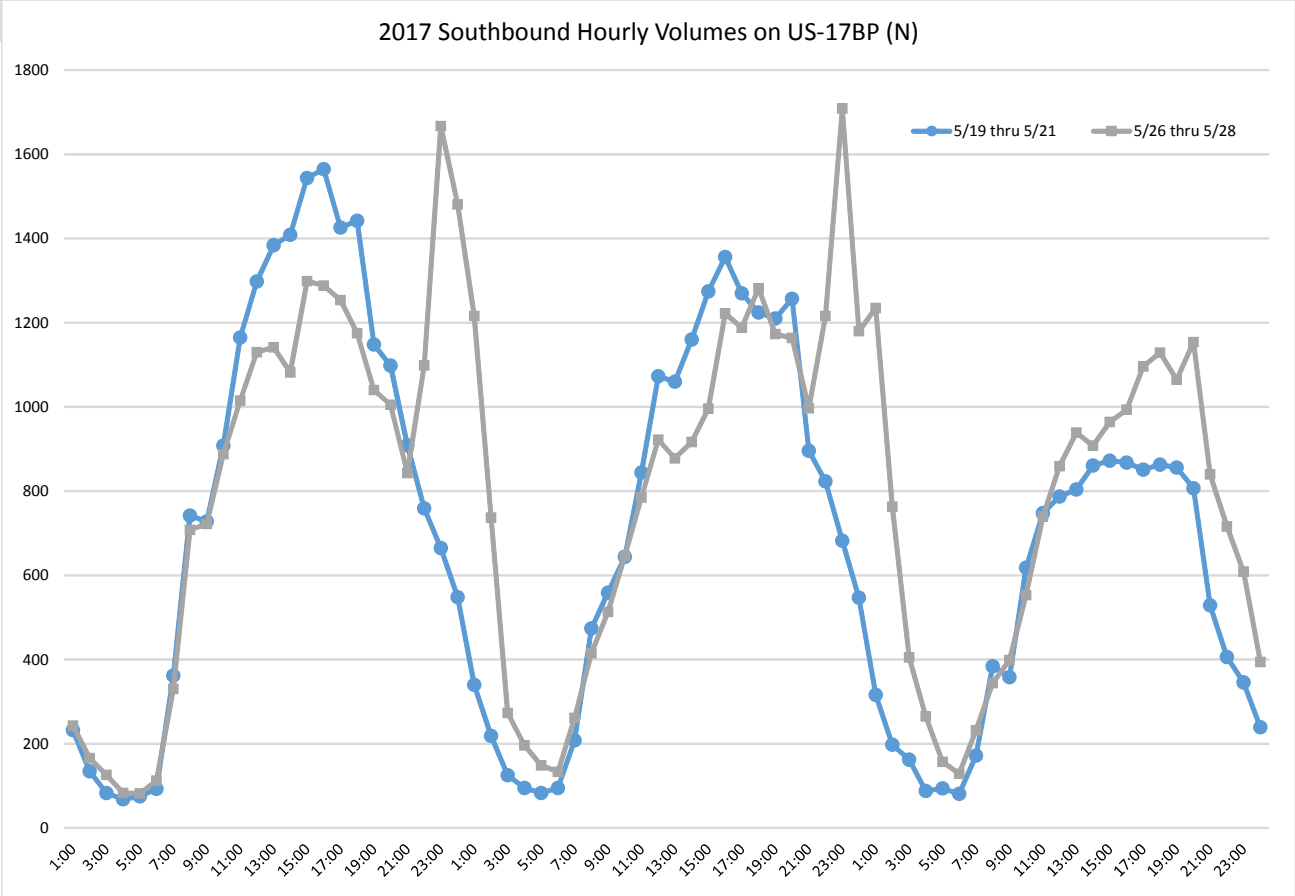
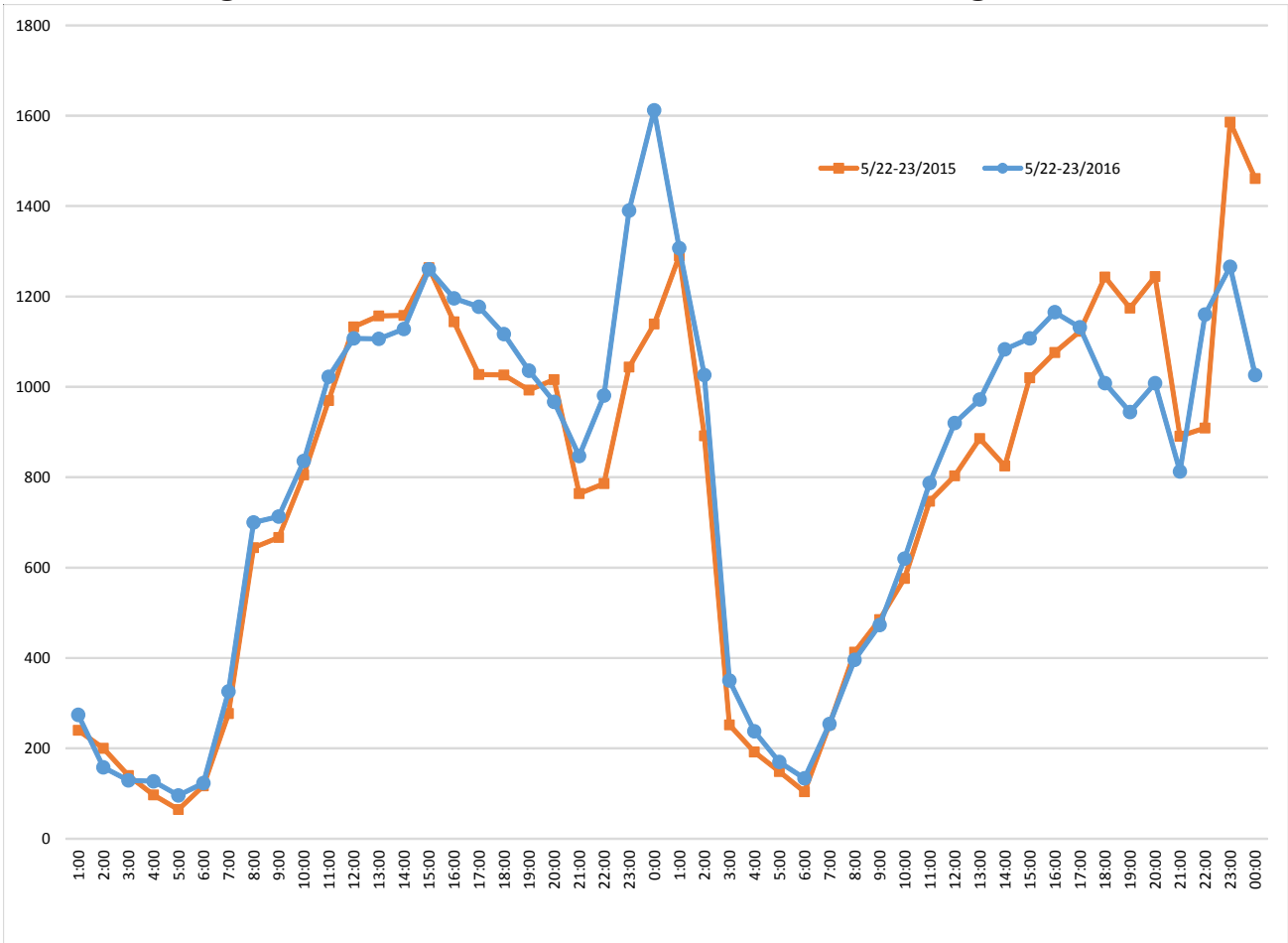


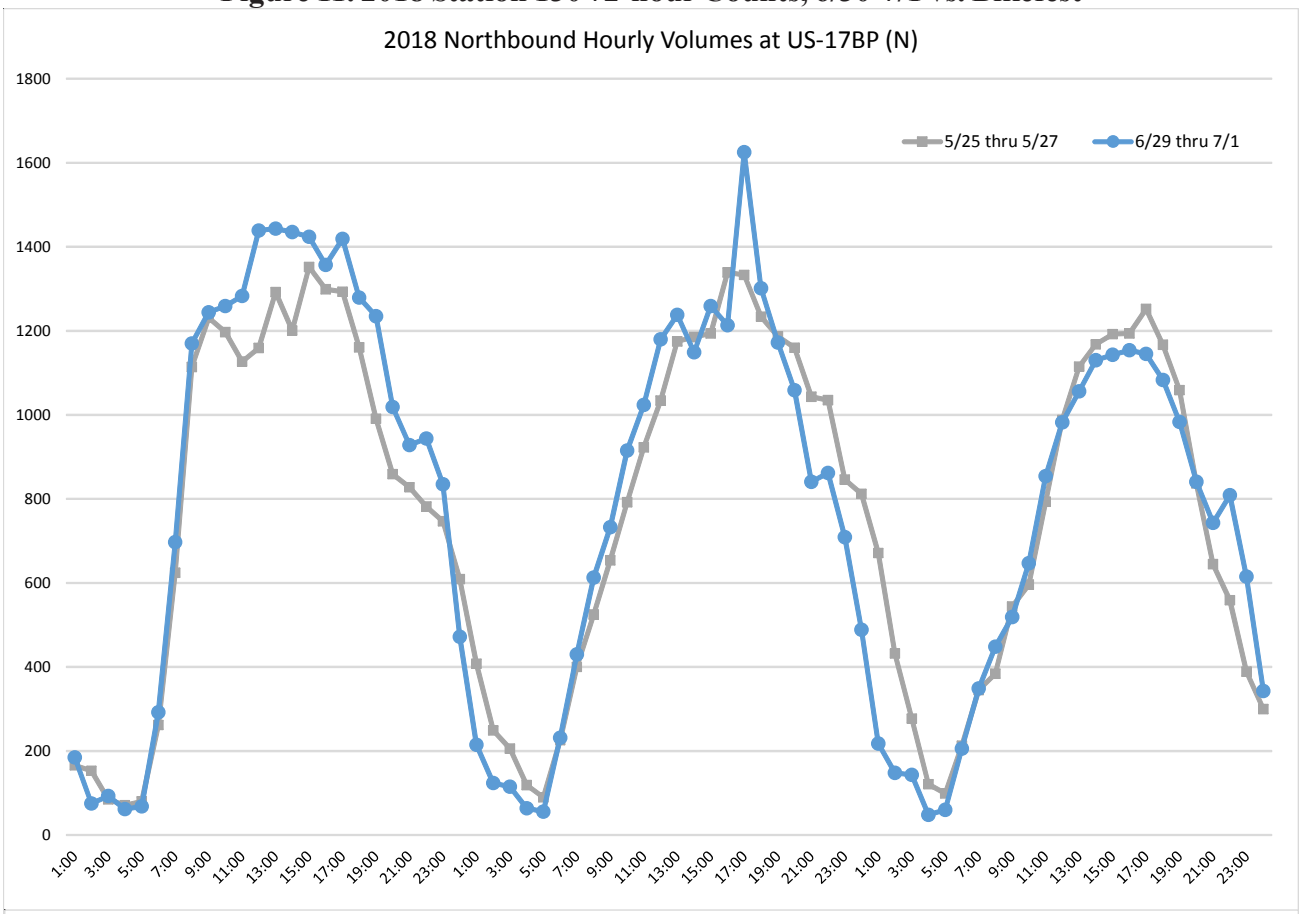
Figure 10. 2015 and 2016 Station 130 48-hour Counts during Bikefest

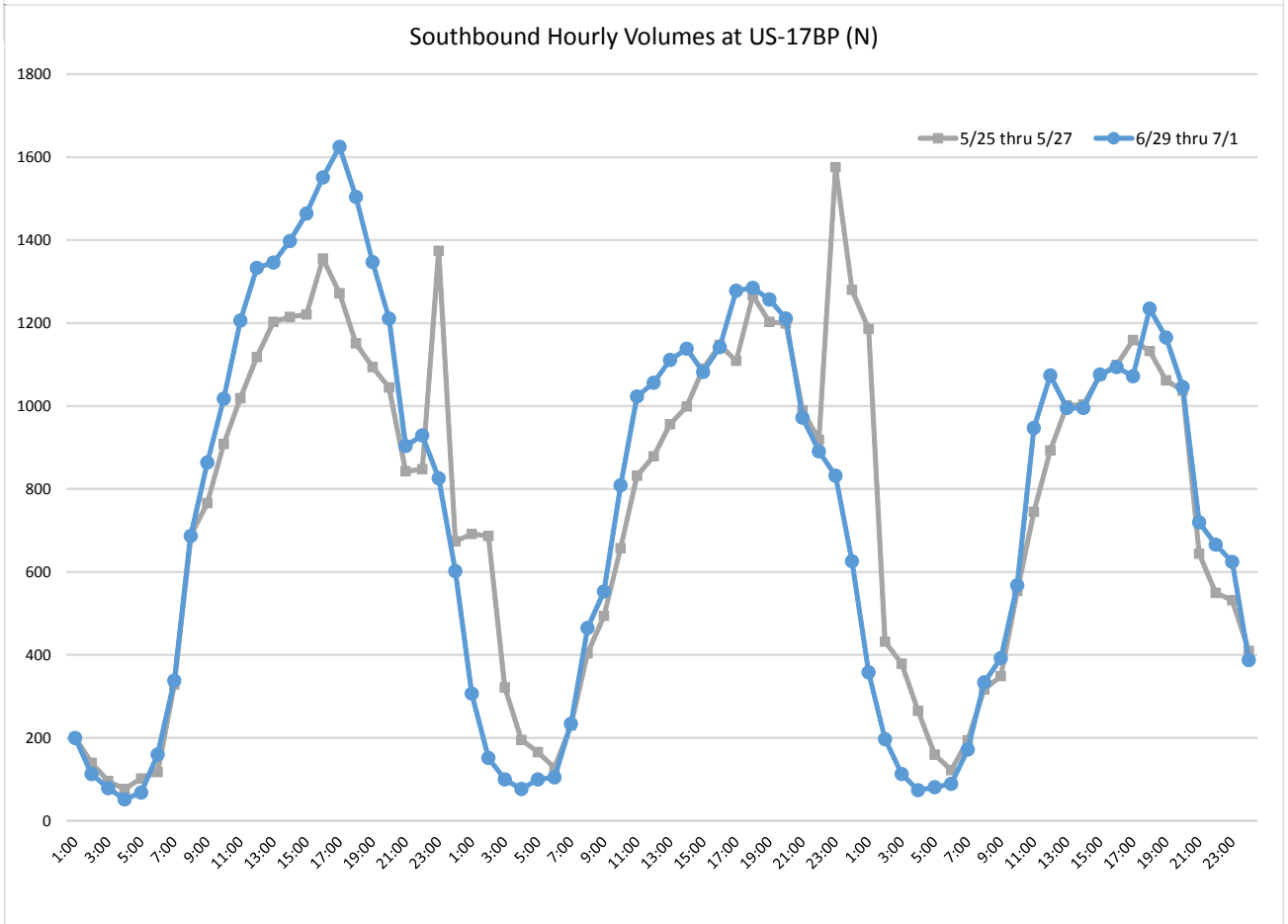


For any given event, traffic demand on a facility can be quantified by factors like trip purpose, temporal pattern, travel direction, and vehicle type. For recurring events such as Bikefest, event attendee surveys, along with event traffic counts and parking occupancy counts, provide a basis for estimating traffic arrival rates over time.

As far as is known, the city has conducted no such studies for Bikefest (or other large recurring events). Without data, differences in demand on Ocean Boulevard for various events cannot be quantitatively determined. Moreover, the City has not identified any specific type of unique traffic demand that occurs during Bikefest. To the extent that they reference a large amount of traffic in the Ocean Boulevard area generally, this seems to be because Ocean Boulevard is particularly visitor oriented, given its beach access and many establishments providing lodging, shopping, amusements, dining, and nightlife. A portion of the traffic along the boulevard is associated with the establishments alongside the road. These businesses are incentivized to maximize visitor access to the boulevard. Each has a maximum service capacity, however, limiting the number of visitors that can be accommodated. Hotels, for example, have a finite number of rooms. The occupancy factors indicate similar residency levels for the events described herein. There is reason to believe that all peak periods attract similar numbers of guests to the other establishments along the boulevard, leading to similar patterns of traffic demand.

Figure 11. 2018 Station 130 72-hour Counts, 6/30-7/1 vs. Bikefest





Impacts of the Traffic Plan

Given evidence that Bikefest traffic demands are not abnormal, one can compare the traffic flow during Bikefest to traffic flow during other weekends to establish whether traffic flows more or less smoothly. All available evidence demonstrates that the plan implemented does not (and cannot) improve traffic flow.

Lane Reduction on Ocean Boulevard

The one-way, one lane Ocean Boulevard operation during Bikefest provides less capacity than the two-way, two lane pattern employed during Harley weekend and throughout the remainder of the year. The theoretical capacity of an urban street lane in a business district is about 1800 passenger cars/hour/lane (pcphpl) under ideal conditions.

Stable conditions reflect traffic moving freely at uniform intervals through a signalized intersection during green periods. Under unstable flow conditions, vehicles are restricted by unexpected slowing or stopping of traffic ahead. Unstable conditions reduce the traffic flow rate. Jam conditions, for example, result in a flow rate near zero vehicles per hour.

It may be impractical during a large event to maintain truly stable flow. Heavy traffic demands can result in saturated or oversaturated conditions. However, proper traffic planning calls for analysis of the likely traffic flow characteristics during an event and development of measures to maximize the level of service. If congestion is expected, active traffic management using trained police officers expedites vehicle movement. Drivers must be kept moving, or traffic flow breaks down.

On a two-lane street, the theoretical two-lane capacity is seldom twice the one-lane capacity. Traffic signals and turning vehicles at STOP controlled intersections influence the capacity of the two open lanes. Nevertheless, the Bikefest traffic plan clearly reduces traffic capacity on Ocean Boulevard. Unless travel demand on Ocean Boulevard became demonstrably lower during Bikefest than for other peak periods, congestion and a poorer level of service for those subject to the one-lane restriction are unavoidable.

Intersection Closures

Closing intersections has several potential effects on Ocean Boulevard traffic.

Traffic flow is most efficient when free of interruptions. Intersection traffic controls—STOP signs and traffic signals—greatly affect traffic on urban streets by interrupting flow. During heavy demand periods, these interruptions contribute to oversaturated traffic flow characterized by high vehicle density, queuing, slow overall speed, and "stop-and-go" behavior. Under such conditions, turning movements at intersections also affect flow.

By removing interruptions and reducing traffic conflicts, closing intersections would seem to have positive benefits. Properly done, which is not the case during Bikefest, channelization and intersection closure could effectively convert the single Ocean Boulevard lane to uninterrupted flow, with its theoretical 1800 pcphpl capacity. However, during other weekends of similar demand, Ocean Boulevard functions with two lane flow and all intersections open.

Moreover, the Bikefest traffic plan leaves Ocean Boulevard traffic signals operational during non-loop operating hours, despite the single lane operation. Signals operated during at least some loop hours in 2017 and 2018, even at closed intersections. Unnecessarily interrupting traffic when demand is high contributes to unstable flow. During non-loop hours when turns are permitted at some intersections, a police officer would be much more efficient at traffic control than a signal. All signals at closed intersections should be in flashing mode or covered.

Intersection closures reduce the route options within the local street network available to the motorist. Intersecting streets permit drivers to exit Ocean Boulevard during periods of congestion. In addition, drivers travelling to locations on Ocean Boulevard can use less congested streets to reach an intersection closest to their destination, minimizing use of the Boulevard. Smart phone apps permit many drivers to get near real time information on roadway conditions, permitting selection of the "best" route to avoid congested locations. Given sufficient drivers with such capabilities, traffic will tend to diffuse across many roads within a network, minimizing overall congestion. The channelization of Ocean Boulevard negates this effect and exacerbates congestion along the route.

Traffic Loop

The City of Myrtle Beach only employs the lengthy one-way loop during Bikefest. While implementation of one-way traffic during events can be a tool to reduce turning conflicts and improve traffic flow, the author is unaware of any loop of this scale being used during other events at any locale. The Bikefest loop as implemented has no positive traffic operations benefits.

If the city intends for the loop to alleviate congestion on Ocean Boulevard, it is unclear how this would happen. There are no controls on the number of vehicles destined to Ocean Boulevard at designated loop access points, regardless of traffic conditions beyond. As long as vehicles arrive at a rate in excess of the boulevard capacity, congestion will result. This is true regardless of the existence of the loop. The loop does store vehicles, ensuring that a single driver can re-enter Ocean Boulevard only at intervals corresponding to the loop cycle time. However, congestion continues as long as total visitors (first time and repeat) continue to arrive at a rate exceeding capacity. The city has no quantitative data on the demand for travel along Ocean Boulevard during Bikefest, or any other event, so there is no basis for concluding that the loop would improve traffic flow.

The loop also traps drivers, forcing them to travel many unnecessary miles. This is wasteful of fuel and reduces the quality of a visitor's experience in Myrtle Beach. From a traffic management standpoint, the plan could easily allow more egress points, particularly near downtown.

The city does not employ a loop at any other time of the year when traffic demand is comparable. The street system functions normally during such times, and there appears to be no demand for such a loop, though congestion is present at some locations.

From a traffic efficiency standpoint, the rationale for the lengthy loop route is unclear. Four major thoroughfares—Broadway/Oak Street, Robert M. Grissom Parkway, US-17 Bypass, and Kings Highway run north-south through Myrtle Beach, and could be part of a much shorter loop. The existing route maximizes the loop length, intentionally discouraging travel to the City of Myrtle Beach and along Ocean Boulevard.

During loop operating hours, drivers travelling within Myrtle Beach must carefully plan trips. Most roads and streets intersecting the loop between the Ocean Boulevard-Kings Highway intersection and US-501 and along 29th Avenue North are barricaded. A properly prepared plan would address impacts of the loop on Myrtle Beach residents and others not participating in the event. Although the City has made an app that is supposed to help people maneuver around the loop, the app was non-functioning the majority of the time the loop was in place during 2018. Similarly, City Manager John Pedersen has proclaimed that the majority of the individuals who enter the loop at this point do it intentionally, despite the many stories that have been put forward of people getting stuck in the loop accidentally despite their best intentions.

The loop also affects access to many businesses located along its roads. Loop travel is required to access or leave hotels, restaurants, and other businesses along the loop side of a road. Due to development

patterns, this particularly affects the Ocean Boulevard and Kings Highway portions of the loop. For example, guests returning to a hotel at the intersection of 24th Avenue South and Ocean Boulevard must enter the loop at 29th Avenue North and drive the length of Ocean Boulevard during loop hours, even if traveling from a restaurant a short distance away on Kings Highway.

Performance Measures

Performance data collected during the bike rally weekends in 2017 and 2018 along with other weekends in 2018 provide evidence of the adverse effects of the Bikefest traffic plan.

Ocean Boulevard Level of Service

During bike rally weekends in 2017 and 2018, team members in GPS-equipped probe cars traveled Ocean Boulevard during evening hours starting at 5:00 pm and continuing until early the following morning. The GPS device automatically recorded vehicle position and time at one-second intervals. During Harley Week, some vehicles traveled in both directions; Bikefest only permitted southbound travel. Additional trips occurred in 2018 during the first weekend in June, the weekend preceding July 4, and the weekend before Labor Day.

During the 2017 rallies, the team used only two probe cars. This proved difficult, as congestion limited the number of trips a single car could make, particularly during loop hours. In 2018, the number of probe cars was increased to six to obtain more samples.

Following the events, the GPS data was processed to obtain vehicle speed and travel time between key points for each run. The key objective was to determine overall travel times on Ocean Boulevard between 29th Avenue North and 29th Avenue South.

Tables 7 and 8 provide average southbound travel times and space mean speeds for 2017 and 2018. The data for both years demonstrate that travel times for Harley Week are significantly shorter than for Bikefest. The average southbound speeds are correspondingly greater during Harley Week than during Bikefest. Both of these measures point to a significant degradation of Ocean Boulevard's level of service (LOS) during Bikefest.

Table 9 shows LOS thresholds for urban streets per the Highway Capacity Manual. The base free-flow speed for Ocean Boulevard is less than the posted 25 mph speed limit. Runs made during light traffic conditions between the 29th Avenue intersections took around 18 minutes, including stops for traffic signals. This reflects a free flow speed of 14.7 mph. Given this, any average speed below 4.4 mph is an LOS grade F. This LOS is characterized by the high delay and extensive queuing typical of oversaturated conditions.

Under the Bikefest traffic plan, Ocean Boulevard operates under LOS F during evening hours. Harley Week and the other weekends show a significantly better LOS under two-way operation, reaching as high as LOS B during Harley Week 2017. The lowest non-Bikefest average southbound speed was during the 2018 pre-July 4 weekend. There has been no call to implement a traffic plan during this period.

As has been demonstrated, there is nothing to substantiate a significant difference in demand during these other weekends. The obvious difference is the traffic plan. Designing a traffic plan that produces a failing grade is contrary to the principles outlined in the FHWA primer, as well as general traffic engineering practice.

For comparison, Table 10 provides evening hour travel time and speed data for northbound movement on Ocean Boulevard during Harley Week and selected other weekends. Again, the endpoints are 29th Avenue

Table 7. Ocean Boulevard Southbound Travel Times and Speeds, 2017

	Average travel time	Max	Min	N	Avg. Speed, mph
5/19/2017	0:33:28	0:47:43	0:19:14	2	9.7
5/20/2017	0:39:45	1:21:28	0:17:47	4	9.0
5/26/2017	1:34:40	1:41:31	1:21:34	4	2.8
5/27/2017	5:07:00	5:07:00	5:07:00	1	0.9

Table 8. Ocean Boulevard Southbound Travel Times and Speeds, 2018

	Average travel time	Max	Min	N	Avg. Speed, mph
5/18/2018	0:31:24	0:44:22	0:18:23	23	9.0
5/19/2018	0:33:45	1:12:27	0:18:53	25	8.7
5/25/2018	1:28:53	2:16:42	0:54:23	11	3.3
5/26/2018	3:04:43	3:48:09	1:58:21	8	1.5
6/2/2018	0:33:00	0:38:55	0:27:06	2	8.3
6/29/2018	0:46:50	0:48:54	0:44:47	2	5.7
6/30/2018	0:56:10	0:56:39	0:55:40	2	4.7
8/31/2018	0:35:11	0:40:14	0:30:08	2	7.7
9/1/2018	0:51:05	1:00:17	0:35:42	3	5.5

Table 9. LOS Definitions for Urban Streets

Travel Speed as a Percentage of Base Free-Flow Speed (%)	LOS by Volume-to-Capacity Ratio[a]	
	≤ 1.0	> 1.0
>85	A	F
>67-85	B	F
>50-67	C	F
>40-50	D	F
>30-40	E	F
≤ 30	F	F

Note: [a]Volume-to-capacity ratio of through movement at downstream boundary intersection.
Source: Highway Capacity Manual, TRB 2010

Table 10. Ocean Boulevard Northbound Travel Times and Speeds, 2018

	Average travel time	Max	Min	N	Avg. Speed, mph
5/19/2018	0:22:16	0:27:01	0:17:18	11	12.2
6/2/2018	0:20:18	-	-	1	13.0
9/1/2018	0:30:52	-	-	1	8.6

North and South. Average travel speeds were quite high, reflecting a good LOS more typical of undersaturated flow.

From the overall higher average speeds outside of Bikefest, Ocean Boulevard is functioning satisfactorily under two-way flow, though certainly not congestion free at all times. Turning movements at intersections do not appear to be significantly affecting traffic flow. Given similar levels of demand, the boulevard should perform equally well as a two-way road during Bikefest.

Traffic Flow Characteristics

The traffic count data collected during the events also permit comparison of the performance of Ocean Boulevard during various events. Table 11 summarizes data taken at four locations along the boulevard during Harley Week and Bikefest in 2017. Table 12 presents similar data collected during the 2018 rallies. Count locations in 2018 were limited to two points, one on either side of downtown.

To allow meaningful comparison, count staff were instructed to monitor similar time periods each evening. Generally, counts of at least one hour were taken at each location during the periods 5:00pm-6:30pm, 8:00pm-9:30pm, and 10:30pm-midnight. During Harley Week, count stations had a person assigned to each travel direction.

Ocean Boulevard Flow Rates

Rates are given in vehicles per hour (vph)—including cars, light trucks, and motorcycles—and in automobiles per hour (aph), which excludes motorcycles. Motorcycles take less roadway space than cars and can ride abreast, so the vehicle flows including motorcycles are comparable with typical flows that reflect passenger cars/hour. The literature does not address conversion of motorcycles to equivalent passenger cars.

Average total flow rates (vph and aph) at any given period are lower during Bikefest than the other weekends. For the other weekends, the total reflects the sum of flows in both directions. For Bikefest, of course, flow is limited to the southbound direction.

Considering the southbound direction only, Bikefest flow rates typically are lower, or at best comparable, to southbound flow rates during other weekends. Thus, the Bikefest traffic plan does not seem to provide any benefit in handling traffic. The Bikefest flow rates, coupled with lower average speeds, also indicate congestion and instability in the traffic stream, despite the diminished number of open intersections.

Flow rates on Ocean Boulevard under two-way operation are similar during all weekends examined.

Traffic Composition

The percentage of motorcycles in Ocean Boulevard traffic trends higher during Harley Week than during Bikefest. One possible conclusion is that Harley Week attendees are drawn in greater numbers to the boulevard than are Bikefest attendees. As the first summer holiday, Memorial Day weekend draws many non-bikers to the beach. As during many other weekends, it is logical that Ocean Boulevard would be a destination for a portion of these visitors.

Use of Cross Streets

During Harley Week 2017, personnel evaluated evening hour traffic moving between Ocean Boulevard and Kings Highway via 9th Avenue North, 8th Avenue North, and 6th Avenue South. Each street is two-way. Table 13 summarizes the findings from these counts.

During the count periods, and under normal network operations, each cross street carried over 100 vehicles per hour per direction during a one-hour count. Traffic was somewhat heavier in the westbound direction.

Table 11. Ocean Boulevard Flow Characteristics, 2017

	2017 Ocean Boulevard Flow Summary								
	Northbound			Southbound			Northbound	Southbound	Southbound
	Average Flow Rate (VPH)	Peak Flow Rate (VPH)	% Motorcycles	Average Flow Rate (VPH)	Peak Flow Rate (VPH)	% Motorcycles	Average Flow Rate (APH)	Average Flow Rate (APH)	Average Speed, mph
Ocean Blvd @ 29th Ave N									
5/19/2017 18:20-19:15	926	1500	32.4%	960	1320	31.7%	626	656	13.8
5/20/2017 18:45-19:45	448	708	46.8%	308	732	50.6%	263	224	7.8
5/26/2017 17:35-19:00	-	-	-	457	648	35.4%	-	295	2.7
5/27/2017 17:00-19:00	-	-	-	103	300	12.1%	-	91	0.9
5/19/2017 21:45-22:15	378	468	38.1%	208	312	40.4%	234	124	5.5
5/20/2017 20:15-21:20	298	492	17.4%	487	600	23.4%	246	373	3.2
5/20/2017 22:45-23:45	187	252	11.8%	270	372	20.0%	165	216	6.7
5/26/2017 22:00-00:00	-	-	-	287	480	25.1%	-	215	2.9
5/27/2017 22:10-00:00	-	-	-	77	216	16.2%	-	65	0.9
Ocean Blvd @ 8th Ave N									
5/19/2017 18:10-19:10	633	780	47.6%	602	780	45.8%	332	326	13.8
5/20/2017 17:25-18:00	573	732	32.0%	715	1008	31.7%	389	489	7.8
5/26/2017 17:15-19:00	-	-	-	391	516	30.1%	-	274	2.7
5/27/2017 17:00-19:00	-	-	-	198	420	19.0%	-	160	0.9
5/20/2017 20:40-21:30	N/A	N/A	N/A	488	708	31.4%	N/A	335	3.2
5/26/2017 20:15-21:45	-	-	-	399	852	36.1%	-	255	2.6
5/27/2017 20:35-21:40	-	-	-	221	396	15.5%	-	186	0.9
5/19/2017 22:30-23:30	534	684	48.3%	467	612	36.4%	276	297	3.2
5/26/2017 22:00-00:00	-	-	-	377	636	21.9%	-	295	2.9
5/27/2017 22:00-00:00	-	-	-	178	468	18.6%	-	145	0.9
Ocean Blvd @ 6th Ave S									
5/20/2017 17:10-18:10	457	600	46.8%	623	732	50.6%	243	308	7.8
5/20/2017 18:15-19:20	461	324	40.6%	472	648	43.2%	274	268	7.8
5/26/2017 17:00-19:00	-	-	-	469	792	27.9%	-	338	2.7
5/27/2017 17:00-19:00	-	-	-	307	540	21.4%	-	241	0.9
5/20/2017 22:45-23:45	534	672	45.7%	506	636	40.5%	290	301	6.7
5/26/2017 22:00-00:00	-	-	-	500	612	22.8%	-	386	2.9
5/27/2017 22:00-00:00	-	-	-	353	576	21.0%	-	279	0.9
Ocean Blvd @ Kings Hwy									
5/19/2017 18:10-19:00	861	1152	42.9%	1054	1548	37.4%	197	396	N/A
5/26/2017 17:25-19:00	-	-	-	770	1044	19.6%	-	619	N/A
5/27/2017 17:30-19:00	-	-	-	1107	1692	18.3%	-	905	N/A
5/19/2017 21:15-22:15	706	948	41.6%	990	1248	37.6%	412	618	N/A
5/26/2017 20:15-21:50	-	-	-	623	972	23.1%	-	479	N/A
5/27/2017 20:15-21:45	-	-	-	629	996	13.8%	-	542	N/A
5/26/2017 22:00-00:00	-	-	-	560	1044	19.3%	-	452	N/A
5/27/2017 22:00-00:00	-	-	-	549	1008	13.5%	-	475	N/A

Table 12. Ocean Boulevard Flow Characteristics, 2018

	2018 Ocean Boulevard Flow Summary								
	Northbound			Southbound			Northbound	Southbound	Southbound
	Average Flow Rate (VPH)	Peak Flow Rate (VPH)	% Motorcycles	Average Flow Rate (VPH)	Peak Flow Rate (VPH)	% Motorcycles	Average Flow Rate (APH)	Average Flow Rate (APH)	Average Speed, mph
Ocean Blvd @ 8th Ave N									
5/18/2018 17:30-19:15	343	636	47.6%	463	612	28.4%	180	331	12.0
5/19/2018 17:10-19:05	N/A	N/A	N/A	378	492	10.1%	N/A	340	11.4
5/25/2018 17:15-19:15	-	-	-	395	516	28.1%	-	284	4.3
5/26/2018 17:00-19:00	-	-	-	224	384	20.5%	-	178	1.3
6/29/2018 20:05-21:05	306	372	1.6%	366	492	1.1%	301	299	5.4
6/30/2018 20:05-21:05	365	468	4.1%	388	456	3.4%	350	367	4.8
9/1/2018 17:55-18:55	409	504	10.3%	428	528	7.7%	367	395	7.4
5/18/2018 22:00-00:00	N/A	N/A	N/A	471	828	39.4%	N/A	285	9.4
5/19/2018 22:00-00:00	N/A	N/A	N/A	420	624	31.1%	N/A	579	7.9
5/25/2018 22:00-00:30	-	-	-	305	564	24.9%	-	224	2.3
5/26/2018 22:00-01:00	-	-	-	212	480	23.5%	-	209	1.5
8/31/2018 19:50-20:50	332	456	2.4%	341	444	5.0%	324	324	6.6
Ocean Blvd @ 6th Ave S									
5/18/2018 17:10-19:10	610	840	40.5%	739	996	26.0%	363	547	12.0
5/19/2018 17:00-19:00	593	972	28.2%	330	576	19.6%	426	265	11.4
5/25/2018 19:15-21:15	-	-	-	412	624	24.3%	-	312	3.1
5/18/2018 22:00-00:00	416	576	49.9%	733	1200	33.9%	208	485	9.4
Ocean Blvd @ 9th Ave N									
6/1/2018 20:40-21:40	351	420	1.7%	364	420	2.5%	345	346	N/A
6/2/2018 17:30-18:30	452	588	1.8%	390	564	4.2%	444	355	9.8

Table 13. Cross Street Flow Data, 2017

	Eastbound			Westbound			Eastbound	Westbound
	Average Flow Rate (VPH)	Peak Flow Rate (VPH)	% Motorcycles	Average Flow Rate (VPH)	Peak Flow Rate (VPH)	% Motorcycles	Average Flow Rate (APH)	Average Flow Rate (APH)
9th Avenue North								
5/19/2017 18:15-19:15	177	312	24.9%	191	276	31.9%	133	130
5/19/2017 23:45-00:45	109	216	30.3%	138	300	36.2%	76	88
8th Avenue North								
5/19/2017 23:40-00:40	42	84	35.7%	91	108	25.3%	27	68
5/20/2017 18:15-19:15	139	252	36.0%	164	240	27.4%	89	119
5/20/2017 21:40-22:40	N/A	N/A	N/A	152	264	27.6%	N/A	110
6th Avenue South								
5/20/2017 18:15-19:15	117	216	32.5%	135	300	23.0%	79	104
5/20/2017 21:30-22:30	113	144	24.8%	123	204	29.3%	85	87

Motorcycles were a significant percentage of the vehicles in both directions. It is logical that other cross streets operate similarly, but personnel were not available to count and verify this.

It appears that the cross streets serve as safety valves for Ocean Boulevard during normal operations. Closure of cross streets very likely contributed to the degradation of Ocean Boulevard's performance during Bikefest.

Traffic Loop

The probe vehicles traveled the loop during the motorcycle rally weekends in 2017 and 2018, as well as selected other weekends in 2018. All trips involved the period after 10:00pm when the loop was in operation during Bikefest. Of course, the loop was only in operation during Bikefest, so drivers simply followed the identical route during other weekends.

During Harley Week 2017, the team did not drive the loop. With only two vehicles, it proved impossible during Bikefest to make more than two circuits per evening during loop hours. During 2018, the six probe vehicles were able to make many circuits of the loop path during Harley Week, largely due to the relative lack of congestion. However, during Friday evening of Bikefest, the loop was discontinued early and the team completed only one circuit. The following night, drivers were able to complete only three circuits due to the extremely long travel time. It also proved difficult to get vehicles positioned to enter the loop at regular intervals.

GPS data from the probe vehicles provided round trip travel times from 29th Avenue North at Ocean Boulevard. Table 14 provides the average round trip times for each day covered. A second table column shows average times to travel between 29th Avenue North at Ocean Boulevard and Harrelson Boulevard at the US-17 Bypass overpass, roughly the half way point and the portion of the loop containing the greatest congestion. Finally, the table provides the average travel times from Harrelson Boulevard at US-17 Bypass to US-17 Bypass at 29th Avenue North, the portion of the loop containing exit points and carrying non-loop traffic.

The average loop trip took about 67 minutes during all non-Bikefest weekends. During Bikefest, the average trip time (using data from 2017 and 2018) is 256 minutes, a 282% increase. Since demand cannot be shown to be significantly different, the traffic plan is the most likely cause of this significant increase in travel time.

Table 14. Loop Travel Times, 2017 and 2018

Date	Ocean @ 29N to Harrelson @ US-17 BP	Harrelson @ US-17 BP US-17 BP @ 29N	Round Trip from Ocean @ 29N	N
5/26/2017	1:50	0:22	2:12	2
5/27/2017	5:34	0:31	6:05	1
5/19/2018	0:41	0:16	1:02	11
5/20/2018	0:48	0:17	1:09	10
5/25/2018	2:16	0:30	3:15	1
5/26/2018	3:55	0:33	5:23	3
6/1/2018	0:47	0:16	1:07	1
6/29/2018	0:53	0:18	1:15	1
6/30/2018	1:04	0:16	1:25	1
8/31/2018	0:38	0:17	1:00	1
9/1/2018	1:04	0:17	1:25	1

During all weekends, the first portion of the loop accounts for the majority of the total round trip travel time. This segment contains all of Ocean Boulevard, which has already been shown to be subject to congestion, particularly when operated under the Bikefest traffic plan. The second loop segment has a lower overall travel time, due to higher capacity and greater speed limits, particularly along Carolina Bays Parkway. This portion showed little variation in travel time among the non-Bikefest weekends. Travel times during Bikefest, while still less than for the first segment, are nearly twice the non-Bikefest times. Congestion around the intersections of Bishop Parkway with Waccamaw Boulevard and Waccamaw Boulevard with Dick Scobee Drive appears to be a factor.

Demand Management

Properly conducted, traffic management planning considers measures addressing both supply and demand. Simply put, the supply side reflects the ability of the transport system to accommodate trips, and the demand side addresses the number and timing of trips desired by users. A successful plan accommodates 100% of the demand at a level of service acceptable to the users.

Background

In quantifying travel demand, planners seek to identify the spatial patterns of travel and how they vary in magnitude over time. Using information on the target population, its trip purposes, trip generating and attracting locations, and travel times or costs between locations, the timing and number of trips expected between various origins and destinations in the study area can be estimated. The data gathering and analysis methodology for this process are well-established.

The fundamental unit of passenger demand is the person-trip—the desire for a single person to travel between specific trip ends (origin/destination). Person-trips are accommodated via the supply side—vehicles and/or infrastructure—represented as a transport mode or modes. A single trip may, in fact, employ a chain of transport modes. Determining how trips will be distributed across different modal options is also important in planning exercises.

The vehicle is a conveyance that accommodates one or more person-trips. It may be exclusively dedicated to users with common trip ends—as an auto shared by friends going to dinner—or it may be shared by users having differing trip ends, as a transit bus. Vehicles have differing performance characteristics and capacities to accommodate users.

For most small cities, the supply side includes the infrastructure accommodating vehicular and pedestrian movement—streets, sidewalks, transit terminals, and parking facilities. These have a finite physical capacity to handle traffic. The challenge in event planning is to make the most efficient possible use of this capacity.

For roads and streets, capacity is typically expressed in terms of passenger cars per hour per lane. This is a measure of the physical ability of the road to handle vehicles of a given type. Other vehicles, like trucks and buses, consume more lane space and have different performance characteristics, so are expressed as equivalent passenger cars.

As demand approaches system capacity, performance becomes increasingly unsatisfactory to users, based on measures like travel time, ability to maneuver, vehicle spacing, and time in motion. Street flow is said to be oversaturated when vehicle demand exceeds capacity or queues develop due to downstream breakdowns.

Methods to Accommodate Peak Demand

The general goal in planning is to accommodate demand, while providing the highest possible level of service. Success satisfies those desiring travel, leaving a favorable impression. This is critical in an event setting or a tourism-based economy that depends on attendee or visitor draw.

It is rarely economical to size infrastructure used for normal traffic flow to handle the infrequent peak periods associated with large events. Such peaks may, therefore, lead to highly saturated or oversaturated conditions unless a well-thought-out traffic plan is implemented. Planners may select from a toolbox of short-term capacity enhancements. For example, temporary conversion of a two-way, two lane road to one-way, two-lane operation doubles lane capacity in the remaining direction. This added capacity expedites movement of heavy arrival or departure traffic generated by an event. Operational measures such as temporary turn restrictions, signal timing modifications, and officer-directed traffic can also improve flow during event related peaks.

Capacity can also be used more effectively by reducing vehicle loading. The true measure of roadway capacity is the number of person-trips per hour served, not the number of vehicles carried. A vehicle has the capacity to carry some number of persons. The load factor is the percent of this capacity used. The product of capacity and load factor, or occupancy rate, is generally used for mapping person-trips to a vehicle trip. A demand of 100 person-trips per hour could be accommodated by 100 passenger cars with an average occupancy rate of 1.0, 50 passenger cars with an average occupancy rate of 2.0, or two buses with an average occupancy rate of 50.0.

In situations where demand is forecasted to be high, effective use of infrastructure capacity is critical. For a given demand in person-trips, the impact on road capacity depends on the number of vehicles handling these person-trips. The planner should select a target vehicle flow rate that permits an acceptable LOS. Knowing the expected person-trip demand and the acceptable vehicle flow rate, the planner can then consider various vehicle occupancy and load factor options and estimate the corresponding vehicle counts. These counts are compared with the target flow rate; those exceeding the target rate would not provide a satisfactory LOS.

For high-attendance events, it is often impossible to achieve a reasonable LOS when the majority of passenger-trips are carried by personal vehicles. FHWA recommends considering event related auto occupancy rates ranging from 2.2 to 2.8. Thus, high demand produces correspondingly large automobile counts, potentially exceeding street capacity. Parking space for these vehicles is another consideration.

To reduce the vehicle count, planners can seek to increase occupancy rates, vehicle capacity, or some combination of both. For example, using buses to serve passenger-trips greatly reduces the number of vehicles needed. One loaded full-sized bus replaces 20 or more automobiles in the traffic stream. Most locations have either transit buses or school buses that can be pressed into service during special events.

In most small cities, event attendees must travel via road or street to the venue. Typically, they start the trip in a personal vehicle (e.g., a car, pickup truck, or motorcycle). To keep vehicle traffic on streets near the venue within the target level, travelers must be afforded the opportunity to reach the venue via a higher occupancy shuttle bus. This requires a parking and loading area where personal vehicles can be safely left and persons can board or exit the bus.

Shuttle busses typically operate in a loop pattern, traveling from the parking/boarding area to the venue site and returning. Depending on the event plan, the bus service may have multiple parking areas and venue pickup and drop-off points. A more complex plan may have several bus routes, each serving one or more separate parking areas.

Trip makers need some motivation to make the transfer to bus. The service must be promoted heavily to the target population in advance of the event. Typical incentives include ease of parking, reduced or free parking, and faster and/or easier access to the venue. Sometimes bus riders receive discount coupons for local businesses. Generally riders pay no fare to ride the bus.

To be successful, the bus service must displace sufficient automobile traffic to provide the target level of service. The bus still travels the local street system, and is thus subject to the same delays in heavy traffic as any other vehicle. Even under congested conditions, though, bus riders avoid the discomfort of driving themselves.

Application to Myrtle Beach

The City of Myrtle Beach has not indicated any consideration of measures to analyze and manage demand in the fashion described. Yet, a plan for accommodating event-related transit appears feasible and should be further evaluated.

The most likely users of a temporary transit service are persons travelling to Ocean Boulevard restaurants, shops, and nightclubs from outlying areas, along with employees of these businesses. The service could be used by persons traveling along the boulevard, but unless operated in both directions would not be convenient for all trips.

Coast RTA already operates fixed bus transit service in Myrtle Beach. Several routes travel along Kings Highway. The Entertainment Shuttle trolley service operates along Ocean Boulevard between 3rd Avenue South and 29th Avenue North. Therefore, equipment and drivers are available. Of course, the transit agency would need compensation for their use.

The former Myrtle Square Mall site, bounded by Oak Street, Kings Highway, 27th Avenue North, and Myrtle Place (aligned with 23rd Avenue North), would be an ideal parking site. This property, presently vacant, has over 2,800 parking spaces. It lies two blocks west of Ocean Boulevard. Other supplies of parking available during evenings exist at area schools, the recreation complex, Coastal Square Mall, and Broadway at the Beach. Obviously, arrangements to use private facilities require agreements with the owner, along with the necessary insurance and security arrangements.

Buses would pick up and discharge passengers at points along Ocean Boulevard. Stopping points should be spaced far enough apart so that the bus does not impede traffic flow, but not so far apart that passengers must walk a long distance to their destination. The paralleling side streets might be advantageous to include in the transit route to further reduce the boulevard traffic load. The route could also employ Ocean Boulevard to travel in one direction and Kings Highway for the other.

Unless quantitative reasons are demonstrated, Ocean Boulevard should continue to function as a two-way street during large events. This presently occurs 361 days of the year with many periods of high demand. It occurred year-round prior to 2015. Using transit to reduce auto demand offers the potential for improved LOS on the boulevard without the major inconveniences imposed by the Bikefest plan.

Even if Ocean Boulevard were to remain a one-way street during Bikefest, both lanes should be available for travel. The lane now reserved for law enforcement and emergency vehicles is hugely wasteful of capacity, and would be better employed as a dedicated transit lane. This expedites bus movement, providing an advantage to bus riders and reducing cycle time. It also prevents the bus from blocking auto traffic during stops. The transit lane should be along the west side of the boulevard so that boarding and alighting is away from traffic. Emergency vehicles could still use the lane. Bus headway would be far longer than that of automobiles, and the TWLTL permits buses room to clear responders proceeding to a call.

Emergency Response

The need to provide access for police, utility, and emergency vehicles is one stated reason for the lane closure during Bikefest on Ocean Boulevard. The closed lane demonstrably lowers the road's LOS by reducing capacity well below that needed to accommodate demand, particularly during peak periods in the evenings. It is very likely the lane closure would have a similar effect were it implemented during other busy weekends.

During other peak weekends, Ocean Boulevard apparently presents no problems for emergency responders, despite the lack of a dedicated lane. This may be because:

a) the road generally operates at a much higher level of service with two-lanes, minimizing traffic-related delays to responders;

b) open intersections, driveways, and the TWLTL provide refuges for vehicles clearing to allow a responder to pass;

c) responders have many access points to the boulevard, since all of the 49 intersections that occur about every 0.1 mile are open.

During Bikefest, in addition to reserving the northbound lane, police and emergency vehicles occupy the TWLTL at many locations.

There is no obvious reason why emergency response could not be handled adequately during Bikefest without a dedicated lane. No fire, police, public works, or medical facilities are adjacent to Ocean Boulevard; all are most quickly reached by roads leading to the west. Access to the boulevard from points to the west permits flexible use of the street network to avoid any potential congestion on the boulevard itself.

The numerous side streets permit nearby access to any location along Ocean Boulevard, minimizing the need for responders to travel very far on the boulevard itself. Even if intersections remained barricaded, pre-selected points for emergency vehicle access could be provided. Barricades could be quickly moved aside to permit emergency vehicles to pass, and would ensure cross streets remain clear.

A dedicated lane does not appear necessary for emergency access, based on the information and data available.

Summary of Conclusions

1. From all available information, there are not significantly more vehicles or people in the Myrtle Beach area during Bikefest than during other busy summer weekends, including Harley Week, Fourth of July weekend, and Labor Day weekend.
2. Traffic counts indicate that generally less than 25% of the traffic on Ocean Boulevard was motorcycles during Memorial Day weekend evening hours, including the loop period. The motorcycle percentage during Harley weekend was typically slightly higher. During both events, automobile traffic predominated on Ocean Boulevard. This raises the question of how much of the traffic during either weekend was related to the motorcycle event, but the City has not taken any steps to assess the answers to that question or to determine what the traffic demand is for the event. Absent credibly forecasted volumes of traffic—motorcycle, event-related auto, and non-event related auto, no logical traffic plan can be developed.
3. The City performed no analysis of the existing road network, including Ocean Boulevard, to determine the expected level of service impacts under normal conditions from traffic during Bikefest or any other

event. Without such an analysis, there is no basis to identify locations expected to experience service degradation and to develop remedial actions. Further, the City did not examine the impacts of the Bikefest traffic plan. Such an analysis, conducted in accordance with accepted methods, would have quickly revealed that the plan unacceptably degraded the levels of service on Ocean Boulevard and other roads in the area.

4. The function of a special event traffic plan is to keep traffic flowing efficiently and prevent gridlock. Large events can produce traffic demands that exceed the capacity of the roadway, resulting in undesirable congestion and potentially halting traffic flow. In urban areas, example measures employed in special event traffic planning include:
   - Changing traffic flow patterns to minimize conflicts
   - Converting two-way streets to one-way to add lane capacity
   - Placing traffic signals in flashing mode or using manual operation
   - Having police officers direct traffic at non-signalized intersections
   - Bringing attendees from off-site parking areas to the venue via transit (bus or van)

5. The City of Myrtle Beach severely restricted traffic flow during Bikefest weekend.
   - Ocean Boulevard was open only to southbound traffic (single lane) between 29th Avenue North and 29th Avenue South.
   - Access to and exits from Ocean Boulevard were limited to 29th Avenue North, 21st Avenue North, Mr. Joe White Avenue, 9th Avenue North, 3rd Avenue South, 9th Avenue South, and 13th Avenue South.
   - A 23-mile extended traffic loop was in effect from 10:00 p.m. to 2:00 a.m. Friday, Saturday and Sunday, May 26-28. This loop forced traffic on Ocean Boulevard to travel to Carolina Bays Parkway to exit the area, or to travel around the loop to return to Ocean Boulevard at 29th Avenue North.
   - Pedestrians were separated from vehicles along Ocean Boulevard from 29th Avenue North to 29th Avenue South. Barriers prevented walkers from entering the roadway except at designated crossing locations.
   - Barriers restricted through traffic flow along parallel streets between Ocean Boulevard and Kings Highway.

6. The City of Myrtle Beach had very few traffic controls in place for Harley Week and other busy summer weekends.
   - Ocean Boulevard remained open during all hours to both northbound and southbound traffic (minimum 1 lane/direction).
   - Access to/from Ocean Boulevard from all but one intersecting side street was unrestricted during all hours.
   - Roads parallel to Ocean Boulevard were open without restrictions at all hours.
   - Pedestrian traffic was unrestricted along Ocean Boulevard.

7. The City of Myrtle Beach provided no evidence that Bikefest produced traffic demands that were any different from those of Harley Week and other busy summer weekends. In fact, the City provided no demand forecasts for either event that would justify any difference in traffic planning, much less the significant difference between Bikefest and all other busy summer weekends.
8. The traffic plan made access to Ocean Boulevard hotels and businesses extremely inconvenient, potentially affecting their patronage during a normally busy weekend. While access was hindered at all hours, it was severely limited during the traffic loop hours.
9. The data reveal that, generally, Ocean Boulevard experienced substantially better performance as a two-way street during Harley Week (and other summer weekends) than as a one-way street during

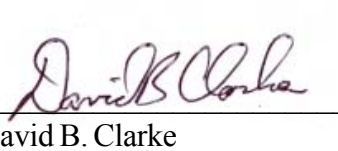
Bikefest. Since demand appears similar for both events, the wisdom of the Bikefest traffic plan is questionable. Bikefest flow rates were generally lower, as was average travel speed, reflecting an unacceptable level of service. Travel times between selected locations along Ocean Boulevard were typically much greater during Bikefest than during Harley weekend. During Bikefest 2018, evening travel times between 29th Avenue North and 29th Avenue South averaged 69 minutes on Friday and 185 minutes on Saturday. In comparison, the travel times during Harley Week were 31 and 34 minutes respectively. The 2017 times were similar.

10. Traffic signals on Ocean Boulevard remained operative, despite the closure of intersecting streets. Given the heavy presence of police, the team did not observe any officers directing traffic to proceed through the signals or help with access/egress to adjacent parking areas. This aggravated congestion on Ocean Boulevard. It is routine during major events to have officers direct traffic, as the officer can make decisions and respond quickly to expedite traffic flow. Normal traffic control devices are poorly suited to high traffic demand conditions.
11. The traffic measures imposed by the City of Myrtle Beach actually hindered the flow of traffic during Bikefest weekend.
12. Limiting Ocean Boulevard to one-way traffic using a single southbound lane ensured that motorists would experience severe congestion when travelling the road during a major event. The traffic demand was simply inadequate for a single lane. This would be true during Harley Week and the other busy weekends observed, given the similar attendance and traffic demands seen during those weekends.
13. The Bikefest traffic plan substantially reduced the capacity of the street network by blocking the majority of cross streets intersecting with Ocean Boulevard and streets parallel to Ocean Boulevard. This forced traffic to remain on Ocean Boulevard longer than necessary, exacerbating traffic demands on the street despite the 50% reduction in capacity. During normal hours, vehicles caught in congestion on Ocean Boulevard had few options to exit the road or to take a parallel and less congested route. During loop hours, motorists had to travel the entire length of Ocean Boulevard to the intersection with Kings Highway and then follow the loop to an exit point.
14. The one-way pattern on Ocean Boulevard, combined with limited (or no) access via cross streets forced motorists to incur additional travel mileage to enter or leave destinations along the road.
15. The traffic loop added additional travel time and inconvenience to motorists in the area, particularly those using Ocean Boulevard, but, in addition, those destined to businesses along other portions of the loop. Measured travel times around the loop during operating hours ranged from over 2 hours to over 6 hours. Notwithstanding the congestion along Ocean Boulevard, the trip from Kings Highway at Harrelson Boulevard around to US-17 Bypass at 29th Avenue North still took an additional 30 minutes or more during Memorial Day weekend loop hours.
16. During loop operation, barricades erected down the middle of streets and at intersections hindered access to businesses and hotels located on the opposite side of the road. Motorists destined to these locations were forced to enter and use the loop, incurring inconvenience, unreasonable delay, and contributing to the traffic load. Police officers made no attempts to expedite access to these businesses.
17. The one-way traffic loop served no useful purpose for traffic congestion management during Memorial Day weekend. There was no reason for implementing this plan given that the weekend demand during Bikefest has not been shown to be significantly more than any other summer weekend in Myrtle Beach. The loop, in fact, increased both travel time and distance for motorists forced to use it. It appeared to have the sole purpose of discouraging travel along Ocean Boulevard during Memorial Day weekend evenings. Given the length of the loop and the time required to traverse it, motorists would tend to avoid the Ocean Boulevard area during the evening hours when the loop was in effect.
18. The loop was confusing and unduly restrictive for motorists not involved with the motorcycle event. Police officers offered no help to motorists inadvertently caught within the loop, as would happen

traveling southbound on Kings Highway from downtown Myrtle Beach. Officers directed motorists to keep moving and refused to allow them to exit or turn around.

19. During Bikefest, the city claims an essential need to reserve one of the two through lanes on Ocean Boulevard for emergency access. No other weekend of the year merits this treatment. The lane closure is a waste of road capacity, and undoubtedly contributes to the severe congestion observed during Bikefest. Emergency responders can access Ocean Boulevard from the west using the many intersecting roads, minimizing the need to travel far along the boulevard. The quickest routes to and from points on the boulevard to fire, police, and medical facilities make minimal use of the boulevard.

In summary, the Bikefest traffic plan is not based upon any demonstrated need, does not follow established planning principles, and actually degrades the level of performance of the roads involved. The city developed the plan without any theoretical basis or any data upon which to evaluate the plan, considered no alternatives, and performed no follow-up to evaluate the plan's poor performance.



Dr. David B. Clarke

12/17/2018
Date

The author reserves the right to augment this report and the opinions contained herein based upon the results of ongoing discovery, additional depositions, and additional documents that may be provided.

Documents and Information Reviewed and/or Relied On

In the course of this analysis, the author employed the following:

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